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SEPTEMBER 1, 1876.

OUR EDUCATIONAL POSITION.

Educate! Educate! seems to be the great cry of the day; nevertheless, by far the greater number of those who join in its utterance attach no definite meaning to the word—and with those few who do it is a meaning which is generally anything but a reasonable and proper one.

Some think the Church Catechism the *sunnum bonum*, others regard this as an abomination; whilst a third set of people have so great a dislike to any religion at all being introduced into ordinary school routine, that they will have none of it. All these people have so little regard for education in the proper sense of the term, that they would sooner that all children should remain untaught unless the system of teaching adopted be accordant with their own views. Luckily, whilst the Polemicals have been fighting, the Educationals have been working, and have somehow or other to some extent succeeded in cutting the Gordian knot as regards Religion as an element of education in public schools, passing on and providing means of instruction in the ordinary routine of mere elementary education, as appears by the Report for 1875 of the Committee of Council on Education, for 3,147,424 children; a very small part of this having, however, been, it appears, due directly to the Elementary Education Act, the great *cheval de bataille* of the Polemicals. The total increase during the last six years being 1,380,480, and out of which the new provision made by School Boards has been for only 386,400 children. It follows, therefore, that to provide schooling for no less than 994,080 children has been the part of the work which has been performed by voluntary efforts. The actual use that has been made of this new school space renders these figures less gratifying. The school accommodation is shown to be very largely in excess of the number of children who have in any way taken advantage of it. The school registers of 1875 contained the names of only 2,744,300 children, and of these about a million were under seven years of age. The average daily school attendance of children of all ages was 1,885,562. The number qualified to be examined by the Government Inspector was 1,141,892, and the number actually presented for examination 973,583. Finally, the number which passed without failure in the proverbial three subjects was 572,781. It is clear that all these figures, and especially the later ones, are very much lower than they ought to have been. It is, however, not easy to pronounce exactly on the amount of the deficit. The problem is necessarily indeterminate, as, indeed, the method of solution followed by the Committee of Council sufficiently proves. The whole number of children in England and Wales of what is termed the school age—*i.e.*, the whole number between three and thirteen, are, the Registrar-General is quoted to prove, 5,374,301. This tremendous total, however, is, fortunately, no fair measure of our educational deficiencies in school accommodation or attendance. We must deduct from it first all who belong to a higher class than that which commonly attends at Public Elementary Schools. We must then make a further reduction for the length of time by which school attendance can be suffered to fall short of the proper total of ten years. These two processes together bring down our figures to 3,224,580, and this, according to the Registrar-General's tables, is the least number that ought to be under daily instruction. The figures we have given above show, therefore, that our existing school provision does not fall very far short of what it ought to be, but they show, too, how very far we are from making proper use of what we have got. For the supply of new schools, if new schools are still needed, we may, says the *Times*, to whom we are much indebted for information on this subject, trust to the machinery which has already been found to work so well. The neglect of school attendance by the classes for which our schools have been called into existence is a matter which needs more special and supplementary care, and this, it will be remembered, it was the great object of the Act of last Session to bestow. The supply, actual and prospective, of qualified school teachers are points on which the report of the Committee furnishes some interesting particulars. The increase here has been considerable. In 1869 there were 12,027 certificated masters and mistresses. By August, 1875, this number had risen to 20,940, and by December to 21,952. The greater part of them come from the training colleges. These, it is calculated, can provide yearly about 1,500 teachers—a number sufficient to make up for the yearly waste in a staff of 25,000, and sufficient, therefore, at present to make some addition to the smaller existing staff. The Committee, however, are not satisfied that the probable future demand will be thus met. They expect to be called upon to provide for at least 27,000 separate departments, or, allowing for the increase of small village school, for 30,000, each under a properly certificated teacher. The excess is to be met, in some part, by the granting of certificates upon examination for actual service and independent of college training, but some doubt is expressed whether the supply will, even so, be adequate. Under these circumstances, we are sure that the Education Department has done wisely in extending the time during which these irregular certificates can be obtained, and in making their terms somewhat easier. It would seem, indeed, that some greater latitude was desirable, so only that a proper degree of competence in the teachers was secured. There must be a very large number of persons well qualified for the work of teaching who would gladly undertake it if their fair claims could be admitted. The salary of a teacher has risen of late years quite in proportion to the large increase in the demand. On the terms now offered there could be no difficulty in obtaining an almost indefinite number of fit candidates if they were sought for in the open market. First-class men from our Universities are sometimes obliged to be content with lower stipends and for higher and harder work. We should deprecate any measure which tended to reduce the standard of qualification in our elementary school staff, but with proper safe-guards we could fear no such result from the freest system of selection that could be devised. Indeed, one may hope that by opening the door to those who have not been ground into teachers of the mere verbal and formal knowledge which now passes for the proper educational course, we shall get some considerable attention bestowed upon drawing, elementary science, and the nature of *things* surrounding us, which are in reality the matters in which instruction and education can be the most usefully applied in order to benefit the people at large; for an intelligent view of *things* is far more important, whether in a personal or industrial point of view, than expertness in the use of *words*.

Reviews.

KASPARY'S INFALLIBLE CRITERION.

"The Natural Laws, or the Infallible Criterion." By JOACHIM KASPARY, Humanitarian. London: J. A. Brook and Co. 1876.

THIS work is one of those polemical books which are not much to our taste; it is, however, so as far as we can see (allowing for the usual amount of self-satisfaction in its tone, which is characteristic of all who seek to set us right, theologically and socially), an interesting and instructive contribution in aid of the cause of true religion and social progress.

As we do not profess to deal with matters to which this book refers, except in the way of passing remark, we shall merely give a notion of its general character and contents as pointed out by the author in his prefatory statements.

It is, he says, "intended to produce a clearer view of the divine government of the universe, and especially of the nature and destiny of human beings, than can be gathered from the study of all the books hitherto written on theology and philosophy. It also contains a complete refutation of John Stuart Mill's opinions expressed in his essay "Nature," and in the last eleven pages of his essay, "Utility of Religion." The author has adopted as far as possible, the phraseology and illustrations employed by John Stuart Mill in order (as he says) to exhibit most effectually the conceit and ignorance, created by scepticism and atheism. The intelligent student of this essay will kindly remember that a discoverer of truth does not meet with assistance, but with opposition from those holding contrary opinions: those who know the author's circumstances, will, therefore, be surprised rather, that his time and finances have permitted him to write and publish this work, than that he is still prevented from writing and publishing large volumes to prove the discoveries alluded to in this essay.

"The author, of course, expects to learn that the wisest and best of the ancients and moderns have been on the threshold (!) of his discoveries. As modern Astronomers and Chemists, however, do not derive their discoveries in astronomy and chemistry from books treating of astrology and alchemy, but from Nature and Natural Laws, so modern Humanitarian philosophers do not derive their discoveries in religion and philosophy from books treating of miracles, the Pythagorean doctrine and nebular theories, but from the God of Nature through Natural Laws. The author, therefore, does not derive his knowledge from those who now and then made shrewd guesses in ignorant and credulous ages, but from his own discoveries, observation and reasoning, in which he has been materially assisted by the scientific and philosophical discoveries of the past and present."

If the author has the opportunity of revising the work, we would advise him to use expressions of less asperity in alluding to persons who hold opinions he seeks to controvert.

NOTES ON BUILDING CONSTRUCTION.

"Notes on Building Construction, arranged to meet the requirements of the Syllabus of the Science and Art Department of the Committee of Council on Education, South Kensington. Part II., Commencement of Second Stage, or Advanced Course." Rivingtons: London, Oxford, and Cambridge. 1876.

THIS Second Part of "Notes on Building Construction" is fully equal to the First Part, and if, as we confidently expect, the Third Part prove as good as both, a complete system of scientific technical instruction for the building trades will be provided by these books published by Messrs. Rivington.

The following extract, relating to matters of building construction, will afford some idea of how the subject is treated:—

"All walls must be expected to consolidate and settle down when weight comes upon them, but so long as they settle equally, no injury is done; *inequality* of settlement, however slight, is dangerous, and produces unsightly cracks in the masonry.

"A want of uniformity in construction leads to such results, and other evils are involved, among which is instability when exposed to the action of fire. With regard to this, Captain Shaw, the Chief of the London Fire Brigade, says:—'The walls of a most pretentious and imposing building, of sufficient thickness, and apparently constructed of sound stones, are found to crack at any stage of a fire, and perhaps to fall down altogether, and then it is discovered that they have been only a deception, having been constructed externally of stone and internally of brick.' In all compound walls the backing should have joints as nearly as possible equal in number and thickness to those in the face, so that the back and front may settle down under pressure to the same extent; if not the joints should be in cement or quick setting mortar, in order that they may become consolidated before any pressure comes upon them.

"*Evils of Facing with Superior Bricks.*—It is a common practice, especially in using single Flemish bond, to build the face work with better bricks and with thinner joints than the backing. This leads to unsound work, and should not be allowed. In such cases, on account of the joints of the backing being thicker than those of the face work, the courses will not be of the same depth in front and back. For example, it may require eight or nine courses of the face to gain the same height as 6 or 7 in the backing, and it is only when they happen to come to a level that headers can be introduced. Even the few that can thus be used are liable to be broken off by inequality of settlement, caused by the difference in the thickness of the joints. This may be partly remedied by using thicker bricks in the backing, but even then the difference in thickness of the joints in facing and backing tends to cause unequal settlement, unless the work is built in very quick setting mortar, which will harden before any weight comes upon it."

The work is illustrated by wood engravings of a practical kind, and altogether this book seems to leave nothing to be desired as regards supplying practical instruction in a scientific way.

MACALISTER'S ANIMAL MORPHOLOGY.

"An Introduction to Animal Morphology and Systematic Zoology." By ALEXANDER MACALISTER, M.B. Dublin, Professor of Comparative Anatomy and Zoology, University of Dublin. Part I., Invertebrata. London: Longmans, Green, & Co.

THIS is a very elaborate and thoroughly satisfactory work on the subject of Animal Morphology. It is, however, so technically scientific that we should despair of conveying anything like a notion of its contents to any one but a student tolerably well up in the subject.

We may however state that the author has been induced to publish this work in consequence of having found that students desire to have a text-book in their hands to enable them to learn the terminology of the science, and by giving them a connected view of varieties of animal forms, to assist them in remembering the practical instruction of the class-room.

There are in English many good works on special provinces in Animal Morphology, and this manual is not intended to supplant such books, but to fit students for the profitable perusal of such works as those of Rolleston, Huxley, Flower, &c.

To reduce the lecture notes to a suitable size, the author has had to condense many parts to the smallest bulk, and to leave out many matters of detail, such as many of the recent embryological researches of Lankester, Metschnikoff, Kowalewsky, and others. He expresses regret that, owing to the long time that this work (written in 1873) has been going through the press, he has not been able to introduce into it references to recent discoveries, such as that of the unisexuality and tracheal system of Peripatus, &c. For the sake of junior students the chief paragraphs are printed in larger type, the details in smaller, so that the general principles can be more easily grasped.

The author makes no claim to originality, having borrowed largely from Gegenbaur, Carus, Haeckel, Huxley, Lankester, Van Beneden, Schmarda, and others, and has endeavoured to avoid the errors of second-hand quotations, and of making extracts from other manuals which are easily accessible to students; and, having been for fifteen years engaged in the practical study of comparative anatomy, has been enabled to verify many of the statements made.

Thanks are accorded to Mr. H. W. Mackintosh for his valuable assistance in correcting the press, and to Professor Reynolds for some suggestions in Chapter I.

Some errors, it appears, have escaped notice in correcting the proofs, the most serious being placing Heliophri variabilis, *Greef*, instead of Heliosophœra radiata, *Sch.*

REVIEW POSTPONED.—"Mines and Mineral Statistics of New South Wales" is a most interesting work; but want of space compels us to postpone our notice of it.

EFFECTS OF TIDE CURRENTS ON HARBOURS.

THE effects of running water are very strikingly perceptible on the banks of rapidly flowing rivers. The channels of the Missouri and Mississippi rivers are continually changing; and the griefs of shipowners and captains, and the shrewd devices of pilots on this account, have been most attractively depicted by Mark Twain. Many a time has a planter retired, with his home and plantation on one side of the river, and awakened in the morning to find that the river had cut a new channel on the other side of his property. The crescent-shaped bayous so common along the south Mississippi, are results of this change of river bed by washing across from one curve to another in a straight line, instead of following the direction of the bend. The work of Captain Eads, now in progress at the mouth of the Mississippi, shows both the effect of water disposition and the ability of man to counteract it by means of jetties which produce scouring action.

That the waves and tides are materially and constantly modifying the physical geography of the sea coast has been long observed. Places which were one on the very edge of the sea are now removed to the distance of miles from the coast line by the agency of tidal deposit; and others, which were formerly at considerable distance from the water's edge, have since been washed away by tidal erosion. The famous pass of Thermopylæ, which was, in the time of Heredotus, so narrow that but a small squad of soldiers was necessary to prevent the passage of the whole Persian army, is now separated from the sea by a vast area of marine deposit.

Professor J. E. Hilgard, of the United States Coast Survey, has made some interesting observations regarding tidal influence on harbours, and the modifying effects of encroachment to meet the growing necessities of large cities. It is well known that a tidal wave, when uninfluenced by the contour of the coast, is but inconsiderably elevated, and the front slope is about equal in length and similar in form to the rear slope. But as it enters a bay, harbour, or river, the crest of the wave becomes more elevated as the passage for it becomes more constricted, and also the front slope acquires much greater abruptness than the opposite one. Consequently the time occupied by the flood tide is shorter than that occupied by the ebb tide. This phenomenon of tides may be artificially illustrated with a very small amount of water, by dashing a bucketful horizontally upon some uneven surface, with projecting points and indentations to represent capes and bays. If the water is projected with slow motion, it will be seen to rise but little at the projecting points, and to rise much higher in the indentations or bays, and the slopes of the waves will present the peculiarities already mentioned.

In the Delaware bay and river, the difference between the mean rise and fall at the Delaware Breakwater and at Philadelphia is only 2½ feet, while the difference of luni-tidal interval between the two places is nearly six hours. At the former place, the mean duration of the flood and ebb tides is about the same, showing that the tide wave has here about the same slope on its front and rear sides; while at Philadelphia, the time of ebb exceeds that of flood tide by about 2¾ hours. At the head of the Bay of Fundy, the mean height of the tide is 36 feet, and at spring tides, 50 or more. And here the tide rises so rapidly—owing to the very abrupt front slope of the tidal wave—that cattle feeding on the shore, and sometimes people, are often overtaken and engulfed or drowned. In the Severn river, England, above Bristol, the whole rise of 18 feet takes place in 1½ hours, and the fall requires 10 hours. As a result of this variation of slope, when a flood tide enters the mouth of a bay—which is usually a comparatively narrow strait—its rapid flow through the strait carries sand and mud with it; and when the water spreads out in the basin beyond, and thus slackens its velocity, it deposits sediment in extensive flats opposite the entrance. The ebb, being more gradual, only washes little channels which converge from all directions to the outlet, leaving much of the deposit behind. Since the amount of water entering a harbour is about equal to that which leaves it at the next ebb tide, it may seem at first thought that the sediment carried out would just equal that brought in; but when we remember that the rise of water is more rapid than its descent, we clearly see that this cannot be. While, therefore, the accumulation of sediment in well sheltered harbours cannot well be avoided, there is one thing which is very largely under human control, and affects very materially the value of harbours for commercial purposes. Man has it in his power to make deeper or shallower the channels of entrance and exit to a harbour by modifying the water capacity of the enclosed basin.

Professor Hilgard affirms that the depth of the channels "will depend, in a great degree, on the proportion of the area of the basin to the outlet, or, in other terms, on the difference of level which will be reached during the ebb between the basin and the ocean, which determines the greatest velocity and transporting power reached by the ebb stream." And even the flats, which are bare at low water, form an element of importance in fixing the depth of the channel. These flats furnish space for the excess of water at flood tide, and also, by their friction, retard the water in its outward flow. The velocity of water, and hence its scouring effect, is due to the height of the water column rather than to its area; but while the rapidity of scour is due to its height, the continuation of its effect must of course depend upon the amount of water. From this we obtain an idea of the risk to harbour navigation which must necessarily attend any encroachment upon the water capacity of a harbour. To emphasize the important lesson he aims to impress, Mr. Hilgard offers as illustrations the two harbours of New York and Charleston.

Of the two entrances to New York harbour, the channel through the Sound is subject to but little natural modification. But it is widely different at the Sandy Hook entrance. In the place where the beacon on the end of Sandy Hook now stands, there was 40 feet of water 15 years before it was built. The cause of this accumulation is attributed to a northward current along both sides of the Hook. This invasion of Sandy Hook upon the best entrance to New York harbour is not a matter to be lightly considered. The depth of this channel, at mean low water, is 22 feet, and is maintained by the water (1) in Raritan Bay and east of Staten Island, (2) in Newark Bay and on Jersey flats, (3) lower waters of the North river, and (4) the Sound tide flowing through Hell Gate. The effect of the last of these is chiefly due to the fact that the Sandy Hook tide wave reaches the docks at New York before that from the Sound, the two meeting at Hell Gate, and the conditions of this tidal circulation are such that, if at the point of meeting a partition were placed, the water on one side would be sometimes 5 feet higher, and at other times 5 feet lower than on the other side. Even in the absence of such a partition, in the most contracted part of the passage the water is often a foot above its level only 100 feet distant. Hilgard estimates that the closing of Hell Gate would cause a loss of not less than 3 feet in the depth of Sandy Hook channel. The effect on this channel of the first three divisions is dependent upon the amount of water and its distance from the bar. The direct and necessary effect of diminishing the area of the tidal basin is to diminish proportionally the depth of the channel. He ventures the assertion that the proposed enterprise of occupying the Jersey flats with dock and wharves "would occasion a loss of not less than one foot in the depth of the bar off Sandy Hook, and certainly not more than two feet." And he very significantly adds the following remarks, which should not go unheeded:—"When we yield to the demands of commerce any portion of the tidal territory, to be used for its wharves and docks, we must do so with full cognizance of the sacrifice we are about to make in the depth of water over the bar; and in order to form any well-founded judgment in regard to the effect of such encroachments, it is necessary to be in possession of the fullest knowledge of all the physical facts involved in the problem, and no measure of encroachment should be determined upon except in pursuance of the advice of scientific experts."

Professor Hilgard seems to attribute the cutting-out of harbour channels to the slow ebb scour entirely, and not at all to the more rapid flood tides. The latter would seem to us most likely to produce the greatest scouring effect. And this would be consistent with the two facts stated by him: that sand accumulates at the bar by being thrown up by waves of the sea; and that the inflowing tide carries the sand and mud with which it is charged into the inner basin, and there deposits it, gradually filling up the harbour. In either case, the amount of scour would seem to depend equally upon the capacity of the tidal basin. But it is probable that much of the sediment is washed down the rivers which flow into the harbours, and settles to the bottom, while the river water is backed up in the harbours by the incoming tide.

During the rebellion, a stone fleet was sunk in the channel at the entrance of Charleston harbour, where the channel was 12 feet deep at low water. The submerged fleet caused a shoal to form, so the water here is now only 7 feet deep; but each side of this, a narrow channel has been scoured out, one 12 and the other 14 feet deep. Furthermore, 4 miles south of this point was formerly a much frequented passage for southern traffic; but since the fleet was sunk, this channel, at first 9 feet deep at low water, has become so filled up that it is now only 3 feet deep, very seriously to the disadvantage of easy communication with southern ports. From this, says Professor Hilgard, "we are warned how carefully all the conditions of the hydraulic system of a harbour must be investigated before undertaking to make any change in its natural conditions, lest totally unlooked-for results be produceed at points not taken into consideration."—[*Abridged from the "Scientific American."*]

SCIENCE DEGREES AT THE UNIVERSITY OF LONDON.

CERTAIN changes have recently been made in the regulations for the University of London's degrees of Bachelor and Doctor in Science. The general nature of these changes is pointed out as regards the former degree in a Report of the Committee to which the revision of the regulations for Examinations in Arts, Science, and Laws was intrusted by the Senate. The Committee, after having revised the regulations relating to the degree of Bachelor of Arts, considered those relating to the degree of Bachelor of Science. Their report says:—"It has come to be generally felt that scientific knowledge, to be real, must be practical as well as theoretical, and that a thorough knowledge limited to a comparatively small range is preferable to a slighter acquaintance spread over a more extended area; and it is the general experience of teachers that there is, from the commencement of their academical course, such a decided preference on the part of nearly all students of science for either the physical or the biological group of subjects that the attention of each student is given to one group almost to the exclusion of the other. It was further urged that the hiatus is too wide between the almost elementary knowledge of the several departments of science required in the Bachelor's examination and the very high attainment in some limited department which is required as the qualification for the Doctorate; and that it would be extremely desirable that this hiatus should be narrowed, by limiting the number of subjects to be brought up by candidates for the B.Sc. degree, and proportionally raising the standard of proficiency required. Several of the ablest teachers in institutions connected with the University, and of its most experienced examiners (past and present), concurred, therefore, in recommending to the Committee that, keeping the first B.Sc. examination nearly as it is, an optional divarication should be allowed at the second between the mathematico-physical and the biological subjects; and the Committee, feeling satisfied that such a limitation would be advantageous, proceeded to carry it out by framing (with the assistance of their examiners and other distinguished men of science) new programmes in the several departments of study, that should suit what are now felt to be their respective requirements. But when these new programmes (in which, wherever feasible, practical were combined with written examinations) were put together, the conclusion was forced on the Committee that, even when the whole aggregate of subjects it was deemed right to include was divided into two groups, the acquirement of the proficiency expected in the several subjects thus grouped would be a task too severe for the average capacities of science students. And, after much consideration and communication with their scientific advisers, the Committee have arrived at the conclusion that it would be desirable rather to diminish the number of subjects which each candidate should be required to bring up at the second B.Sc. examination, than to exact anything short of the 'competent knowledge' of each subject for which these programmes provide. They are further of opinion that each candidate, instead of being required to include either the whole or a part of the subjects he selects in one or other of the before-mentioned groups, should be allowed a free option among all of them, so as to combine them in any way that may best suit his taste and ulterior objects—thus leading him onwards to the still higher specialization of the Doctorate. Acting on this principle, the Committee have framed a new set of regulations for the degree of Bachelor of Science, which they now submit to the consideration of the Senate. In the first examination, which every candidate will be required to pass, while the programmes in mathematics, experimental physics, and inorganic chymistry have been carefully revised, little fundamental change has been made in them. In place of the superficial acquaintance with both zoology and botany formerly required at this examination, the Committee now recommend a single examination (written and practical) in general biology, in which a more thorough knowledge shall be required of the simplest forms and elementary phenomena of animal and vegetable life, such as is now made the basis of the teaching of some of the most distinguished Professors in each department. Thus the student who may be intending to devote himself specially to physical or chymical science will be brought to apprehend the general conceptions common to the two great organic kingdoms, without being required to master the specialities of either; and the student who intends to present himself at the second B.Sc. examination in either physiology, zoology, or botany, or all combined, will have laid the best foundation for those special studies in the study of general biology. The regulations for the second B.Sc. examination, on the other hand, are framed with the view of allowing the candidate to bring up any three of the following nine subjects:—(1) Pure mathematics; (2) mixed mathematics; (3) experimental physics; (4) chymistry; (5) botany, including vegetable physiology; (6) zoology; (7) animal physiology; (8) physical geography and geology; (9) logic and psychology. It is intended by the Committee that the examinations in these several subjects should be, as nearly as may be, on the same grade, as to the amount of attainment they require. They have learnt from the Examiners in Mathematics that their experience justifies them in stating that any candidate who has thoroughly mastered the mathematics of the first B.Sc. examination, and who has such an aptitude for the study as would lead him to select pure mathematics as one of his subjects at the second, would find no difficulty in mastering the requirements of its programme by such an amount of study, carried on through an eight months' academical session, as would leave him free to bestow the same amount of time and attention on two or even three other subjects. And the Committee would wish it to be understood, therefore, that in proposing that each candidate should have his choice of any three out of the nine subjects just specified, the amount of proficiency expected in each would be that which he might attain by the steady devotion to it of about one-third of the sessional work of a diligent student. We understand that the Senate has revised the regulations for the science degrees in accordance with these recommendations by the Committee. It may be well, however, to point out in addition that in the Matriculation Examinaton, which forms the basis of the science curriculum, German may now be taken in substitution for Greek. In regard to the Doctor's degree, a change has been made in favour of candidates who prolong the interval between their first and second examinations for the degree of Bachelor from one year to two or more, as such will be allowed to come up for the degree of Doctor of Science within a year of their attaining the degree of Bachelor.

INSTITUTION OF CIVIL ENGINEERS.

SUBJECTS FOR PAPERS.—SESSION 1876-77.—The council of the Institution of Civil Engineers invite communications, of a complete and comprehensive character, on any of the subjects included in the following list, as well as on other analogous questions. For approved original communications, the council will be prepared to award premiums, arising out of special funds bequeathed for the purpose, the particulars of which are as under:—

1. The Telford Fund, left "in trust, the interest to be expended in annual premiums, under the direction of the council." This bequest (with accumulations of dividends) now produces nearly £260 annually.

2. The Manby Donation, given "to form a fund for an annual premium or premiums for papers read at the meetings," of the value of £10 a year.

3. The Miller Fund, bequeathed by the testator "for the purpose of forming a fund for providing premiums or prizes for the Students of the said Institution, upon the principle of the 'Telford Fund.'" This fund (with accumulations of dividends) now realises about £170 per annum. Out of this fund the council have determined to establish a series of scholarships, to be called "The Miller Scholarships of the Institution of Civil Engineers," for papers from students, and to award one such scholarship, not exceeding £40 in value, each year, and tenable for three years.

4. The Howard Bequest, directed by the testator to be applied "for the purpose of presenting periodically a prize or medal to the author of a treatise on any of the uses or properties of iron, or to the inventor of some new and valuable process relating thereto, such author or inventor being a Member, Graduate, or Associate of the said Institution." The annual income amounts to rather more than £16. It is proposed to award this prize every five years, commencing in 1877.

The council will not, in any case, make an award unless a communication of adequate merit is received; but, on the other hand, more than one premium will be given, if there are several deserving memoirs on the same subject. In the adjudication of the premiums no distinction will be made between essays received from a member, an associate, or a student of the Institution (except in the cases of the Miller and the Howard bequests, which are limited by the donors), or from any other person, whether a native or a foreigner.

List. 1. The triangulation survey, and mapping of countries and districts, including the astronomical observations required for latitude and longitude, the measurement of bases, the description of the different ininstruments and methods employed, the reduction of the observations, and degree of accuracy of the results. 2. The levelling of countries, either by spirit-levelling, vertical angles, barometers, or the boiling-point of water; with a description of the instruments employed, the reduction of observations, and degree of accuracy of the results. 3. The existing standards of mechanical power in different countries. 4. The varieties of clay, and their respective values and treatment, for brick-making, for puddle, and for the construction of embankments, whether for railway purposes, reservoirs, or dock walls. 5. The nature of slips in rocks and earths of different kinds, and the conditions that induce treacherous ground in railway-cuttings, tunnels, and the sides of valleys near reservoir banks. 6. The application of steam machinery for excavating, and the cost as compared with hand labour. 7. The process of forging by steam hammers and other percussive machinery, and by the hydraulic press. 8. The results of experience in the recent extended use of steel in mechanism and in works of construction. 9. The best mode of uniting steel and other metals employed in boiler work and other constructions, and the effect of the operations of punching, drilling, and riveting on such metals. 10. The construction of warehouses and other buildings for storing goods, with the special view of resisting fire, and the relative merits of stone, brick-work, iron, and timber for that object. 11. Road-making, with special reference to the methods adopted in large towns, or where the traffic is heavy, including a comparison of the first cost, maintenance, and durability of the different systems. 12. The different systems of sinking wells for foundations in gravel and sandy river beds, and the best mode of obtaining foundations where the sand extends to depths of from 60 feet to 80 feet. 13. The arrangements for erecting large numbers of girders, of from 100 feet to 200 feet span, over rivers whose beds are almost dry for one-half the year, and are flooded for the remainder of the year. 14. The design and construction of masonry dams of great height for retaining water in reservoirs. 15. The storage and filtration of water, both natural and artificial. 16. The distillation of water for drinking purposes. 17. The constant service of water supply, with special reference to its introduction into the metropolis, in substitution for the intermittent system. 18. The design, generally, of iron bridges of very large span, for railway traffic. 19. Dock gates and caissons, including a description of the requisite external and internal arrangements, with recent practical examples. 20. The design and construction of building-slips for large vessels. 21. Percussive and other rock drills. 22. The appliances and methods used for tunnel-driving, rock-boring, and blasting, in this country and adroad, with details of the cost and of the results attained. 23. A history of any fresh-water channel, tidal river, or estuary,—accompanied by plans and longitudinal and cross sections of the same, at various periods, showing the alterations in its condition,—including notices of any works that may have been executed upon it, and of the effect of the works. 24. The relative value of upland and of tidal waters in maintaining rivers, estuaries and harbours. 25. The different systems of the towage of vessels. 26. The causes limiting the speed of railway trains, and the possibility and probability of removing those causes. 27. A description of existing railway brakes, with the motive-power employed in their application, and the comparative results which have hitherto been obtained. 28. The construction of steam boilers adapted for very high pressures. 29. The best practical use of steam in steam engines, and the effects of the various modes of producing condensation. 30. The results of experiments on steam jacketing. 31. The modern construction of marine engines, having reference to economy, by superheating, surface condensation, high pressure, great expansion, &c. 32. The construction of portable steam engines, or other motors, of very light weight, suitable for light boats, aërial machines, &c.; and on condensing with air.

33. The relative advantages of different classes of steam engines for the performance of given work, for example: the comparative merits of Cornish engines and direct-action engines for pumping water from a mine. 34. The relative cost of the conveyance of coal by rail and by steamer, and the best mode of loading and unloading to diminish breakage. 35. The various

descriptions of pumps employed for raising water or sewage, and their relative efficiency. 36. The employment of wind and water as motive powers, their relative advantages and disadvantages compared with steam power, and the motors most suitable for utilising them in the best manner. 37. The use of gas as a moving power. 38. Compressed air as a motive power, particularly as applied to machinery in mines and to locomotives in tunnels, with some account of its application on the Continent. 39. The best methods of removing grain in bulk from a ship to a warehouse, of distributing in the warehouse, and of storing grain in bulk. 40. The manufacture of mineral oils, and the lamps best adapted for their consumption in dwellings and lighthouses. 41. The "output" of coal in the United Kingdom, as compared with that of other countries, illustrated by statistical tables, plans, and diagrams, showing where coal is produced, and where and how it is consumed. 42. The sinking to, and the machinery applied at, deep coal mines (in Saxony, for instance), with a notice of the modifications necessary in future coal mining operations suggested (or indicated) by the working of deep sinkings. 43. The appliances used in different countries for dressing the ores of lead, copper, zinc, and tin, and the smelting of such ores, with details of the results and cost by vaious methods. 44. The appliances and processes for the manufacture of patent fuel, in Great Britain and abroad, especially in France. 45. Coal winning and quarrying without explosives. 46. A comparison of the different modes of transmitting power for auxiliary purposes on board ships, and in shipyards, and engine factories. 47. On recent progress in telegraphy, including a notice of the theoretical and practical data on which that progress has been based; with some account of the improvements in the construction of land and sea lines and in the working instruments.

Instructions for Preparing Communications.—The communications should be written in the impersonal pronoun, and be legibly transcribed on foolscap paper, on the one side only, leaving a sufficient margin on the left side, in order that the sheets may be bound. A concise abstract must accompany every paper. Two series of illustrations are required for every paper accepted for reading. One set of wall diagrams, sufficiently large and boldly coloured, so as to be clearly visible when suspended in the theatre of the Institution; and a set of drawings on tracing paper, to as small a scale as is consistent with distinctness, ready to be engraved for insertion in the Proceedings. The wall diagrams will be returned. Papers which have been read at the meetings of other societies, or have been published in any form, cannot be read at a meeting of the Institution, nor be admitted to competition for the premiums. The communications must be forwarded to the house of the Institution, No. 25, Great George-street, Westminster, S.W., London, where any further information may be obtained.—Charles Manby, Honorary Secretary, James Forrest, Secretary.

AMERICAN VIEW OF THE THUNDERER BOILER EXPLOSION.

The double-turreted ironclad Thunderer was recently the scene of a terrible boiler explosion. The vessel was built some three years ago, but had never been fitted for sea, nor had her machinery tested. She had eight boilers of the common low pressure type, which supplied steam to twenty-six small engines for performing various work, besides to the main propelling engines of 800 horse power. An official trial having been ordered, on the measured mile, near Spithead, steam was got up. The safety valves were supposed to be loaded to blow off at 30lbs., and a large force of experienced firemen were employed under the chief inspector of machinery. Fires had not long been started when a loud, sharp explosion, exactly resembling the report of a 38-ton gun, was heard, and vast clouds of steam poured up from below. The destruction was terrible. The men in proximity to the boiler were torn to pieces, while others, cooped up in the after-hole, were literally boiled to death. Fifteen persons, including the chief engineer, were killed instantly, and fifty-six were wounded. The end of the forward boiler on the starboard side was blown completely out, the uptake and main steam pipe were hurled bodily away, and the after fire room, generally, was a ruin.

It was supposed (and in the detailed accounts of the disaster which have reached us by mail, it is so stated) that a deterioration had taken place in the boilers, rendering them weak, owing to the lapse of time intervening between their reception from the contractors and the special trial. A telegraphic despatch, however, coming before the mail, reported the result of the official investigation, and the accident appears to have been due to the most inexcusable negligence. Previous to the steam trial, the boilers had been tested by hydraulic pressure, and, of course, all the safety and other relief valves were tightly fastened down by steel wedges. The wedges were forgotten. The pressure soon exceeded the strength of the plates, and the explosion was a necessary consequence. Those watching the steam guage must have seen its rapid ascent, and certainly it seems impossible that they could have failed to remark that the safety valve was not lifting after the 30lbs. set pressure had been attained, and to have taken measures promptly to discover the cause; but the most cautious of men, on the other hand, cannot reasonably be expected to forsee and guard against the consequences of such inconceivable blundering as here appears to have been the case. This is the third serious disaster which has occurred to the English ironclads within a year, the previous casualties, the sinking of the Vanguard and the collision of the Iron Duke, being due to negligence but little less culpable.—*Scientific American.*

FOREIGN SCIENCE.

MM. Weissback and Jauka, Austro-Hungarian official medical officers at Constantinople, have been examining a great number of individuals of the most diverse nationalities, and from their researches it would appear that the most perfect type of the human form is represented by the "dolichocephales orthognates" with short arms, whilst the "brachycephales prognathes" with long arms are placed at the bottom of the scale. Would that the *elixir vitæ* could really be found is the commentary which we have received from some of our associates, including old militaires. We have seen some other mineralogical notices, which give the following descriptions:—Spertassine (yellow) of Saint Marcel in Piedmont. It is presented ordinarily in masses of a clear yellow colour, and more rarely in crystals of orange yellow. It gives silica, 38·50; alluminium, 18·40; ferric oxide, 2·70; mangan oxide, 36·25; lime, 5·87; Bastete Schillenpath of Isle of Elba. Its colour is olive-green. Analysis, silica, 39·10; aluminium, 3·61; iron oxide, 8·03; magnesia, 33·60; lime, 3·28; water, 12·60.

Proceeding to the alpha in matters scientific is often useful; hence we welcome one of the recent parts of the proceedings of the Academie des Sciences, containing some papers on early arithmetic, such as the art of counting in the fifteenth century, and reproduced in Italian language by M. Alph Sparagna; and a work and some historical researches very extensive of the Prince Boncompagni on an arithmetical treatise of Giovanni Widman di Eger.

Proofs of ingenuity are constantly cropping up in every department, useful and ornamental, and the French papers ceaselessly have to chronicle new inventions worthy of record. A M. Dufour has just invented, according to *Les Mondes* of 17th ultimo, a generator in use at present at Compiègne, particularly noticeable for its smoke-burning furnace, which kindling, by means of cinders and a little coke, the carbon oxide contained in the smoke before it enters the tubes of the third cylinder effects in the first instance a great economy. This little furnace burns the smoke so well that it is on its escape from the chimney more transparent than steam. It vapourizes six teen *litres* of water for a kilogramme of coal; therefore it gives 75 for 100 in economy of combustible over the heaters with boilers. On the other hand the Hamburger, *Jartenzertung*, narrates that the manufacture of flower pots by means of cow-dung and earth has become a practice in Germany on a great scale. Last year, 16,000 were employed in a single establishment. They are recommended for strength, but they cannot be buried in a hot bed. They are, however very useful for cuttings. Even when they are dry, the roots of the plants penetrate into the flanks of the pot, and there find nourishment. They are made by machinery; a man can make 700, 900, or even 1,000 in ten hours. There are machines of two dimensions; the two inch by two, cost two francs.

The multifarious *Cosmos* contains very little information indeed of late upon any matters relating to mechanics or manufactures in iron. This is a falling off. We mean the condition on the Continent—there are clippings from the English newspapers and magazines. In photography, M. Bourdon has presented a radiometer to the French Society, and contests its usefulness employed as a photometer in photography. As heat plays the powerful part in the motive action manifested, and not light alone, he says it can only give uncertain indications from the point of view of application to photometers.

A new colouring substance has been discovered from a tree of Taluti called *musa fehii.* It secretes a gluey juice—*rouge framboise*, when it is observed in little coats or violet blue *en masse.* The liquid is dissolved in all proportions, without any trouble, in water and alcohol, to which it communicates a colour of a great intensity.

A good deal of attention is paid just now in France to the manufacture and to the adulteration of soaps. M. Ferd. Springmuhl, of the Chemical Society of Paris, reports that the weight is often fraudulently increased by the introduction of worthless matter. Some of these are gelatinous, hindering evaporation, and forming a homogeneous mass. The type is aluminium precipitate. To find these, the soap must be dissolved in alcohol, using a filter. Alcohol is decidedly the best test. A very useful book on "Agricultural Chemistry" has been produced by M. Bobierre, of Loire-Inferieure, records from 1850 to 1875. It embraces a good deal about fossil-phosphates. In medical and surgical views, stress has been very properly laid upon the delirium to which operators are subject. Dr. Gueniot tells of an estimable colleague that in an operation upon a woman, "a prey to delirium, became unable to guide or restrain his hand, and had become violent like a man in a fight." In fact, it might often be said to be a duel between a doctor and his patient—a duel, alas! in which conqueror and victim are worthy of pity. If there be anything in this, we hope the medical faculty of this country will pay attention to the subject. Viewing the increase of operations with the progress of science, we should conceive this to be highly necessary.

In optics, the helioscope of M. S. Merz, is a mechanism which permits the surface of the sun to be observed without exacting the employment of coloured glasses. Its construction comprehends a machinery of polarisation which is wedged between the cap and the eye-glass, and placed near the eye-glass. This machinery is formed of two prismatic boxes, A and B. The box A is fixed on the tube of the telescope; in the interior of the two boxes are four large mirrows, a, b, c, d. The rays which come from the eye-glass reach the mirror A, under the angle of polarisation, and are successively reflected by other mirrors. In this way polarised light is obtained, and the scope of vision appears more or less obscure, according to the degree of rotation given to the box B, in relation to the box A.

The work of annual revision of the magnetic map of France was commenced on the 28th of last June.

This year the declination in certain unmeasured points is to be fixed, and portable instruments to be applied to measuring inclination and absolute intensity. Some of these last are specially designed for the determination of magnetic elements of the globe in circumnavigating voyages.

THE ANALOGY OF SOUND AND LIGHT.

A FREE lecture in connexion with the Loan Collection of Scientific Apparatus at South Kensington was recently given by Professor Barrett, M.R.I.A. of the Royal College of Science, Dublin, on "Some Experiments illustrating the Analogy of Light and Sound." Major Festing, R.E., took the chair. The Professor commenced by referring to some of the well-known facts about light and sound, such as that sound waves travel through air while light waves travel through "luminiferous ether," &c. Among many illustrations of the rate at which each travels, he gave this as a very intelligible one:—If a cannon were fired in London the sound would take about eight minutes to travel to Birmingham, a little over 100 miles, while in the same time the light from the flash would have travelled to the Sun, a distance over 90 millions of miles. But though they so differ in the rate of progress, both light and sound show many phenomena in common. In the experiments made during the evening the sensitive flame was used as a detector of sound. This delicate acoustic reagent familiar to London audiences through Professor Tyndall's lectures, was first, we believe, discovered in 1866 by Professor Barrett, though he modestly did not allude to the fact. Indeed, most of the experiments shown during the evening formed the subject of a paper read by him before the Royal Dublin Society, in January, 1868, and the discovery of the ratios referred to at the end of the lecture was announced in the *Quarterly Journal of Science* for 1870. The performance of the experiments, however, was entirely new to a London audience. The analysis of the phenomena of light and sound were illustrated in the following order:—1. Both light and sound get feebler as they leave their source of origin. In the case of sound this was shown with a loud ticking watch and a sensitive flame. 2. In reflection, the angle of incidence is the same as the angle of reflection. In the case of sound this was shown with the sound of a whistle sent along a tube, and reflecting along another placed at an angle to it from a reflector placed at the end where they approached. The distance to which a feeble sound might be reflected perceptibly from a concave mirror, was shown with mirrors over 30ft. apart. 3. With refraction, in the case of light, familiar convex lenses were used, and in the case of sound analogous but less familiar lenses of gas of a different density from air were used. A collodion balloon, filled with carbonic acid gas, served as a doule convex lens, and its action was manifested by the concentration of sound from the ticking watch on to the sensitive flame. 4. Both light and sound suffer absorption in passing through non-homogeneous media. Professor Tyndall's apparatus showing the "echoing back" of sound in passing through successive alternating layers of gas of different densities is now well know, and every one is familiar with the fact that though light may traverse a vessel of clear water, it can no longer travel when it is filled with bubbles of transparent air. 5. There is an analogy between the sympathy among the same notes of a gamut and the sympathy among individual colours in the spectrum. An incandescent body that produces a particular bright band in the rear of the spectrum, will, when in a gaseous state, absorb light and cause a dark band in exactly the same part of the scale. Tuning forks, wires, or columns of air in jars are responsive to vibrations produced by others exactly in unison, but only to those. This was shown in various ways in a very clear manner. 6. An analogy, which Professor Barrett called a more fanciful one, was spoken of. All the complex music of an orchestra is the result of a few simple notes variously combined. So all the tints of a picture are the results of a few simple colours variously combined. The musical scale sorts the complex notes in one case, the spectrum sorts the complex colours in the other. Professor Barratt, taking Professor Listing's determinations of wave lengths has made a most interesting comparison. The wave lengths of the notes of the gamut he expresses not in absolute but in relative measurement. Thus C is taken as 100 and all the other notes have their wave lengths expressed in percentages. Similarly red is taken at 100, and the wave lengths of other colours are expressed in percentages. This interesting result comes out in comparing the two columns. O and orange are each 89; E. and yellow, 80; F. and green, 75; G. and the average of the blues, 67; A and violet, 60; B and ultra-violet, 53; C and the obscure rays (black), 54. Further, the comparison of harmonies comes out in an interesting manner. Low C and upper C sound well together, so red and black go well together. Red and green, and C and F harmonize well, but red and orange no lady would wear, and C and O make a combination by no means pleasant. Red and blue, or C and G, also go well together. 7. The concluding part of the lecture was devoted to an illustration of the figures described by vibrating bodies. Several apparatuses for this purpose were briefly referred to, but especial attention was given to an apparatus of great ingenuity devised by Mr. S. F. Pichler. It is exhibited in the west gallery, No. 7,596. Professor Barrett showed it with an electric light and a reflection on to a screen. The principle of it may be thus described:—Two metallic vibrators, each with a small speculum, are fixed at right angles to each other, and sounds are produced by a current of air acting on one or both of them at pleasure. The perpendicular vibrator is tuned to a given note; the horizontal vibrator is fitted with a mechanical arrangement whereby its pitch can be graduated to any degree of nicety within the compass of two octaves. An apparatus is also provided whereby a pencil of light is concentrated upon the speculum of the perpendicular vibrator, whence it is reflected to the speculum of the horizontal vibrator. For lecture purposes artificial light is used, which is further reflected and magnified upon a screen. When musical sounds are produced by the vibrators, various luminous geometrical figures are formed on the horizontal speculum and reflected on the screen, by the single or joint action of the vibrators described by the pencil of light; and the form and motion of such figures demonstrate the exact relations to each other of the musical notes produced. Sounds which harmonise to the ear produce regular figures to the eye, as, for example, segments of the circle, ellipses, ovals, circles, or straight lines; and if the amplitude of each vibrator be equal, these luminous figures will hover on the speculum or screen, with an apparent steadiness, like that of the heavenly bodies hovering in the sky. If the sounds do not harmonize, the figures are confused, unsteady, and complicated, presenting an appearance as if the wave lines were contending with each other. The mathematical relations of musical notes are also demonstrated, regular simple forms being produced by combinations of those notes which result from vibrations bearing a definite numerical ratio to each other, while irregular and unsteady figures are caused by notes which have no such ratios. The pattern made on the screen by a discord is very bewildering to the eye. Professor Barrett in concluding said after seeing how musical notes may be translated into moving lines of light, the words put by our poet into the mouth of Lorenzo have additional interest.

"There's not the smallest orb which thou behold'st
"But in his motion like an angel sings."

Major Festing conveyed the thanks of the audience to Professor Barrett.

A **NEW TEST COLOUR.**—The flowers of the violet and iris have recently been found to yield a very fine blue colour, which is a more delicate test for acids and alkalies than the solution of litmus commonly employed. The name of the new colour is phyllocyanin. It will probably before long find its way into all chemical laboratories.

ANKLE SUPPORTS FOR SKATES AND IMPROVED SKATES. — This invention consists of an outwardly curved supporting rod that is applied to a socket pivoted to the side of the runner. The supporting rod makes it easier to beginners to learn to skate, while it gives to the accomplished skater a support for the lower muscles, so that he can hold out longer and practise with less fatigue. The second invention relates to such improvements in skates that the same may be instantly and rigidly applied to the heel and sole of the shoe. A set screw allows the adjustment of the skate to any size of heel, while a swinging lever produces, by being carried up until retained by a stop lug on the runner, the tight attachment of of the skate to the boot heel, releasing the same when the lever is lowered and the griping of its sharp edge is discontinued. The front part of the boot or shoe is connected to the skate by an adjustable toe holder.

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President, SIR ANTONIO BRADY.

TO MEMBERS OF COUNCIL.

The Session 1875-6 being ended, Council meetings according to notices, which will be sent by post.

Subscriptions are payable to Mr. G. A. Stretton, the Receiver, 4, St. Martin's-place, S.W., who is the proper official to give receipts.

F. W. Campin, Sec.

Proceedings of the Institute.

The Executive Council met on Thursday, July 27th, when after the confirmation of the minutes of the last meeting as correctly entered, the Secretary, Mr. F. W. Campin, reported that since that meeting he had received a visit from some gentlemen who came to see him on behalf of the Society of Telegraph Engineers, who were taking up the question of Patent Law Reform, in consequence of a communication from Sir William Thompson, and in compliance with their request he had supplied those gentlemen with full information as to the propositions adopted by the Institute, which they found to be largely in accord with those set forth in the communication referred to; but as it was thought (as the event has since proved) that the Government Patent Law Bill would be abandoned, it was suggested that present action would be unnecessary; but it was thought that before the next Session of Parliament it might be desirable to hold a conference of all parties interested, with the view of concerted action.

Upon this Report a discussion ensued, in which Mr. A. J. Murray urged that in any measure promoted by the Inventors' Institute the interest of the Inventor should be the main point, as the public interests would be sure to be taken care of by our legislators, and he moved that it would be desirable to print and circulate the original Bill of the Institute. This was seconded by Mr. Calley, and carried unanimously.

Mr. T. Paterson urged that it would be desirable in any proposed measure care should be taken to sweep away the absurd notion that a Patent was a Royal Privilege, and not a claim of Right.

A resolution was passed unanimously on the motion of Mr. A. J. Murray, seconded by Mr. T. Paterson—"That Mr. F. H. Varley be Chairman of the Executive Council for the current year, to preside thereat in the absence of the President of the Institute."

Mr. T. Paterson then made a suggestion that it would be desirable at a future meeting of the Council to consider the advisability of the Institute in some way promoting the organization of an Exhibition or Exhibitions of Inventions, which would afford the benefit of the moderate kind of protection available under the Industrial Exhibition Act.

After confirming the admission of a number of new members, with a vote of thanks to the Chairman, the meeting then concluded.

Monthly Notices.

More School Boardism, to use a term now required to designate the extreme action of those wonderful men who by virtue of a little brief authority deem themselves zealous educators, has been shown by the case not long since noticed in the daily journals, of a man with a wooden-leg, who swept a crossing at the West-end of London, summoned to Bow-street Police-court for not contributing money towards the education of his son, when Mr. Flowers, the magistrate, asked whether (as it is reported) he could pay 1s. a week, and adjourned the summons.

Mr. Walter de Gray Birch is shortly to publish his long-expected work entitled "The History, Art, and Palæography of the Utrecht Psalter." It is dedicated, by permission, to the Rector and Professors of the University of Utrecht.

M. Decharme, Professor of Physics in the Ecole Supérieure des Sciences d'Angers, communicates to *L'Institut*, of the 2nd of August, an interesting note, "On the Comparative Sonorous Qualities of Divers Metals."

The Internal Constitution of Magnets, is the subject of a paper in the *Comptes Rendus de l'Académie des Sciences*, by M. J. Jamin. The result of his researches, made with considerable care, is to justify the employment of thin plates in the construction of magnets. He states that a bundle of plates will always be more powerful than a bar of the same steel, and that the ratio will increase indefinitely with the number of plates.

Mr. J. W. Judd, as Lecturer on Geology in the Royal School of Mines, is to succeed Prof. Ramsay, whose retirement has been already announced. Mr. Judd was for several years an officer on the staff of the Geological Survey, and in that capacity worked out the structure of parts of Lincolnshire and adjacent counties. After resignation of this appointment, he contributed to the publications of the Survey a valuable memoir on the Geology of Rutland. His numerous writings on Scottish geology, on volcanic phenomena, and on other geological subjects bear testimony of his high scientific character.

Dr. Thomas Oldham has retired from the directorship of the Geological Survey of India. He will be succeeded by Mr. H. B. Medlicott, and the vacancy left by this gentleman's promotion will be filled by Mr. R. B. Foote. Dr. Oldham is at present in this country, and Mr. Medlicott is expected here shortly.

The Entomological Society held a meeting on August 2nd, Sir S. S. Saunders, V.P., in the chair. Mr. F. Smith read a "Note on *Nematus gallicola*, Steph.," the Gall-maker so common on the leaves of species of Salix, but of which the male had, apparently, not previously been observed. From 500 to 600 galls collected by him in 1875, he had obtained a multitude of females, but only *two* males; and he thought that by perseverance in this way it would be possible to obtain the males of this and other allied species of which the males were practically unknown, the female being capable of continuing the species without immediate male influence; and he argued from this that the long-sought males of Cynips might some day be found by collecting the galls early in the year. He expressed his belief that Mr. Walsh had proved beyond question the breeding of a male Cynips in America, although the precise generic rank of the supposed Cynips was disputed by some of the members present. The President (Prof. Westwood), who was unable to be at the meeting, forwarded some "Notes of the Habits of a Lepidopterous Insect parasitic on *Fulgora candelaria*," by J. C. Bowring, and the Rev. R. P. Murray forwarded a paper by Mr. W. H. Miskin, of Brisbane, containing "Descriptions of New Species of Australian Diurnal Lepidoptera in his own Collection." Mr. Edward Saunders communicated the third and concluding portion of his "Synopsis of British Hemiptera-Heteroptera."

Rhodeine is the name which M. E. Jacquemin has applied to a beautiful rose-coloured derivative of aniline which he has recently discovered. Its production (says the *Athenæum*) appears to place in the chemist's hands a remarkably delicate test for aniline; but the colouring matter is said to be too fugitive to admit of its application in the arts.

AËRONAUTICAL SOCIETY OF GREAT BRITAIN.

TENTH ANNUAL REPORT FOR THE YEAR 1875.

THE annual meeting of this Society was held the latter end of June, 1875, at eight o'clock, in the Rooms of the Society of Arts, John-street, Adelphi. James Glaisher, Esq., F.R.S., presided over a fairly-well attended meeting. The audience included several ladies. Particular interest attached to the present assembly in view of a paper by Mr. Moy, on his recent invention of "The Aërial Steamer."

Mr. F. W. Brearey, the Secretary, began the proceedings by announcing that Mr. Glaisher would take the chair.

The Chairman, on assuming that position, said:—Ladies and Gentlemen, it has fallen to my lot on several occasions, as you are aware, in the absence of the President, to occupy this chair, and on each occasion I have had some points of progress to indicate in regard to the labours of the past year, and on the present occasion there is perhaps as much to speak of as in any one of those years. I have now merely to speak of the intricate and difficult problems which so many good men have been endeavouring to solve. Two of our own members, Messrs. Moy and Shill, have been spending I should be sorry to say how much money, but, more than that, they have been spending I do not know how much time; but I am not ignorant of the very high ability with which they have devoted themselves from time to time to the construction of a new steam engine on their own pattern. They have achieved a degree of success which I could scarcely have expected last year, and they have now produced a machine which has lifted vertically a weight of 120lbs. This fact is so important and so pregnant with our future success that I will not now longer occupy your time with speaking of it, as we have Mr. Moy himself here to explain to you what he has done and what he still expects this engine will be able to do.

Another prominent feature in the past year's work is the sad calamity abroad. It was the case of gentlemen devoting themselves not to the mere pursuit of novelty, but using the balloon with a view of increasing our knowledge, and in that pursuit they lost their lives. It was a sad calamity, but I will not dwell longer upon it now, as I thought you would expect from me some particulars of the journey which ended so fatally, and I have been furnished with many facts by my friend, M. Tissandier, and I shall devote some time this evening to speaking upon them; therefore I will not now claim your time longer, but will ask Mr. Moy to give us, as fully as he thinks proper, the results he has achieved.

Mr. Moy read a paper on "Aëronautical Progress."

After indulging in a diatribe upon the inclination of man to destroy birds in the name of sport, Mr. Moy read as follows:—

When I first began seriously to contemplate mechanical flight, now nearly 30 years ago. I had very little hope of imitating any of the numerous living examples which I saw continually around. Like a great many more I thought, for some years, of the "displacement theory." A certain amount of gas of small specific gravity, enclosed in a certain bag of a certain shape, and propelled by some suitable power, and the best that man could do would be accomplished. This was my idea from 1847 to 1859; but in this period the steam engine had made some rapid strides, and engines of something less than one ton to the horse-power had been made, and I began to think that steam might after all be made available to propel aëroplanes, and that Henson and Stringfellow might have succeeded if they had had more power, with a more effective imitation of nature.

In 1865 the celebrated "Reign of Law," by His Grace the Duke of Argyll, was read by many with an interest which was entirely due to its merits, and after much thought upon the subject in that year, I discovered that an inclined plane might be driven at any reasonable speed, whether fast or slow, with the same power, provided the front edge was rigid and sharp, and that the angle was made only sufficient to prevent falling at the desired speed. From that moment I abandoned gas.

After much thought and time we had the exhibition of this Society, in 1868, at the Crystal Palace, which gave a fresh impetus to the activity of my mind upon the subject, and many plans were formed, half matured, and thrown aside for more hopeful ideas. Amidst all this hard work it was always kept in mind that the motive-power required remodelling, and having looked about in vain for a suitable steam engine, I thought out the steam engine which is well known as the "Moy and Shill engine," and in which the great, cumbrous, separate boiler is entirely done away with.

Having got the motive-power, the next step was to apply it; and here the road was anything but a royal one. I have heard members of this Society urge the *necessity* of density and gravitation to the accomplishment of aërial flight; but I can assure those members that there is nothing easier than to retain density or weight, and that the law of gravitation *fully* recognizes every pound of the weight. The great trouble is to get rid of sufficient density, and so to reduce thereby the effects of gravitation, that the motive-power will be strong enough to overcome that amount of gravitation which cannot be get rid of. To do this it is useless to have recourse to displacement, as this at once makes the resistance so formidable that speed becomes impossible.

It would take too much time to trace the successive steps which have been made. In 1869 I had settled the main features of the aërial machine, or, as we will in future call it, the "aërial steamer."

Diagrams handed round.

The diagrams, figures 1, 2, and 4 (handed about) showed how revolving and fixed aëroplanes are disposed, with the engines in the centre of the cabin. One pair of wheels were to be driven by one engine forward, and the other pair by the after engine, and the four wheels so geared together that one engine was at the half-stroke, while the other was at a dead point, in order to insure continuous motion.

A great deal of time and money was expended in carrying this out. The novel patterns for this engine were made from my drawings by my partner, Mr. Shill. The castings were of gun-metal; diameter of cylinder 2 inches; length of stroke 2 inches; steam at 100lbs. to the square inch was cut off at one-eighth of the stroke.

The revolving planes were fitted into hoops made of pine, 6ft. diameter, wire in tension being used instead of spokes, like the well-known bicycle phantom wheels. The outer planes were so adjusted that as they rose upward in their successive revolutions they received an upward pressure on their under surfaces, and for about 200 degrees of the revolution the pressure was on the reverse side of the planes, and thus the effective action was without any wasted effort.

Numerous reconstructions took place in the engines, valve gear, framing, wheels, &c., until it was thought advisable to design another engine with greater power. This was commenced last autumn, and I think I may say that it has turned out to be the best engine for its weight that has been yet constructed.

Mr. Moy then proceeded to give particulars of the experiments which had taken place at the Crystal Palace, but, as they were embodied in the "Concluding Remarks" of the Annual Report for 1874, this part of Mr. Moy's paper has been omitted in this report. His paper continued as follows:—

Every real inventor has to deal with the irrepressible objector and the self-styled "practical man," and I may say that the stupidity exhibited by the objectors to this steam engine for the last three years is something marvellous. I need not repeat their objections here. It is simply a steam engine, and in it steam is raised rapidly, used economically and effectually, and weight can be reduced to a minimum when required; space is also greatly reduced as well as first cost; and if those advantages are not sufficient I should like to know what will satisfy the fastidious requirements of the irrepressibles. If any one still doubts the merits of this steam engine, let him produce a 3-horse engine which will lift in air 50 per cent. more than its own weight; a 6-horse engine will lift in air 100 per cent. more than its own weight; or a 100 horse-power engine which will lift forty hundred weights, and then, *if* he can do that, I surrender.

Now, having cleared the ground, I come to practical application.

I propose to build an engine of 100 horse-power, ascertain exactly what it will do by dynamometer, then build the aërial steamer with sufficient surface, cabin accommodation, and steering apparatus, to make it rise vertically from the ground, and when clear of the trees, &c., to alter the angles of the aëroplane wheels and aëroplanes so as to travel in any required direction.

You will notice in the diagram that the revolving aëroplane wheels are perfectly horizontal. This gives a vertical effect so as to raise it directly from the ground. Having done this the orbit of the wheels can be altered so as to cause the impulse to take a diagonal direction, when the steamer will travel in the direction of the arrow. If higher speed is required the aëroplane wheels are made to assume a more vertical orbit, and the pitch of the planes is increased, the fixed planes coming more and more into action as the speed is increased; and when it is required to slacken speed, the angle of the orbit of the aëroplane wheels is caused to approach again to the horizontal position, and the speed can be reduced as desired.

But you will say this is all very fine talking, but what surfaces will you employ, and what materials will you be able to adopt? This has all been thought out, and tables made from data already obtained, which show that, for a really practical machine, very little else than steel and gun-metal will be required, so that it will be more of the style of a stag-beetle than a butterfly.

It is quite as easy to get 50lbs. to the square foot of surface as it is to get one pound; and when we get 50lbs. we can use metallic surfaces, and the space travelled is passed through at a much higher speed. The revolving aëroplanes also to a large machine can be made far more efficient than those of a model, and comparatively lighter.

If any of you were to attempt to model a windmill, on the scale of half-an-inch to the foot, with its delicate controlling apparatus, you would find it simply impossible to keep to scale; yet the real working windmill is comparatively very easy to make, and so it is with the model aërial steamer. Many important parts are obliged to be entirely omitted in the model which would be absolutely necessary in the large steamer, and could, on a large scale, be made comparatively light; and thus it is that we can calmly contemplate making a large aërial steamer suitable to carry passengers with comfort, and to condense all our steam and use the condensed water again in the boiler, to make the engines on the compound principle, and the various arrangements for steering and controlling the steamer all complete and handy, while in models these must be omitted because they would be too delicate.

One is met with such singular remarks on this subject that a few more particulars would not be out of place here The body, or, to use a ship-building phrase, the "hull" of the aërial steamer will be 70ft. in length, 8ft. beam, and 8ft. in depth, well trussed to give longitudinal stiffness. This will be of metal, and a considerable portion of the roof and sides will be cellular, having about an inch of space between the outer and inner surfaces. The outer surface will, of course, be in contact with the air, the inner surface will be in contact with the air in the cabins. The space between these two surfaces is a receptacle for the exhaust steam. Every one knows that when the exhaust steam is let into this space it cannot continue steam; it must condense, and in doing so it parts with its latent heat, which is, of course, taken away by these metallic surfaces. The water trickling down the sides will be passed again into the steam generator to be again converted into steam, and thus render unnecessary any great store of water, and the heat parted with by the condensed steam will warm the cabins. There is no reason why the cabins should not be made comfortable, and at whatever speed the steamer travels the aëronauts would never be exposed to the current of air. All the controlling gear will be trained into the cabin, and windows will be fitted in the sides and bottom of the cabins to enable the aëronauts to travel by observation. The steering to the right or left will be effected by means of the driving wheels, the angles of which can be altered at will, and the amount of elevation can be effected by the fixed and steering planes.

With some general remarks this paper concluded.

On the conclusion of the paper,

The Chairman said there was one question of the paper which Mr. Moy could make clearer, and that was, whether the 120lbs. weight had been determined by a Salter's Balance?

Mr. Moy said they found the Salter's Balance was interfered with by the motion of the piston. They weighed the machine carefully and found it weighed 186lbs. They then put little levers, one on each side, with weights, to take off all above 120lbs. The machine then rose an inch-and-a-half from the floor.

The Chairman: Then it was determined by actual experiment? because the paper led us to think that it was based upon calculation only. It is evident that it is an absolute fact that it did rise this height from the ground.

Mr. Moy: The Duke of Argyll and the other noblemen and gentlemen present were quite satisfied with it.

Mr. Brown: It does not appear to me whether the engine, boiler, and framework completely rose. Did the whole machine go up?

Mr. Moy: The engine with its generator and frame weighed 80lbs. It lifted 120lbs.

Mr. Brown: I suppose the whole went up?

Mr. Moy said 80lbs. was the weight of the engine, therefore the engine lifted itself and 40lbs. besides. Balanced levers lifted 66lbs. of the whole 186lbs.

Mr. Wenham remarked that he had little to say on the general subject, but as Mr. Moy was flying a light engine he could give him a little information on the subject. He (Mr. Wenham) had prepared a condenser. The exhausted steam was passed into a chamber where 15 cubic feet of air was sufficient to condense one foot of steam. The condenser was very light, the walls being made of tin plate. Condensation was obtained simply by mixing steam with air, in a way that seemed never to have been practically done before. Mr. Moy, as a practical man, would see that such a condenser could be made of the thinnest metal; tin plate, in fact.

Captain Greenfield, R.A.: It may be interesting to gentlemen here to have the evidence of an outsider on this matter. In Mr. Brearey's absence during the spring, when he was suffering from injuries received in a railway accident, I officiated for him for a short time as secretary of the Society, and on the strength of that basis Messrs. Moy, Shill, and Childs very kindly invited me to these experiments on Monday last before the Duke of Argyll, the Duke of Sutherland, the Earl of Dufferin, and several others. I took notes of what I observed, and recorded the revolutions and the amount of work done. I should first describe how the engine was arranged. It rested on the floor on its base. The engine was resting on a very narrow base against the framework of the machine, and the two ends—that is to say, the spindles of the wing wheels, were supported by little levers, the arms of which were of equal length, and each one was weighted to about 33lbs. on each side, making 66lbs. on both. 66lbs. weight was thus taken off the engine by those little levers. The work to be done was to raise—no matter whether one inch, one foot, or one mile—the work was to raise the whole engine, then weighing 120lbs. One of the wing-planes having been broken previously to the experiment, there remained on the one side only eleven wing-planes against twelve on the other side, consequently the wing on one side was unable to do its work completely; therefore I found the complete and perfect wing rose much more than did the imperfect one. The complete one rose on one occasion six inches, lifting the whole body of the apparatus a distance of two inches from the ground; therefore the work done was that 120lbs. was lifted by the apparatus within itself two inches from the ground at the very least. On the other side it was lifted six inches.

The Chairman: Vertically?

Captain Greenfield: Vertically. This was done with the assistance of 66lbs. at the extremities, without any other power than the revolution of the wings in the air; but that was in still air, not in moving air. There was no draught at the time the machine was in motion. I have reason, from what I saw then, to believe that, by a slight re-adjustment, the engines ought to be able to do more than that. In a space of 94-5 seconds I made a calculation of 99000 odd pounds of pressure.

Mr. Moy: Foot-pounds?

Captain Greenfield: Foot pounds of course. The wings being unequal in operating there was a good deal of oscillating motion. One wing was unable to rise as much as the other, but at last, as I say, one wing rose six inches and the other rose two inches, giving a mean of three or four inches. (Applause.)

The Chairman: I am sorry I was unable to be present last week to see those experiments. I now rise to ask you to give a vote of thanks to Mr. Moy for his paper. As I observed in my opening remarks Mr. Moy has spared neither time nor money, but the results have been what you have heard. The remarks by Capt. Greenfield on these experiments are exceedingly valuable. I have now to ask you to give your heartiest thanks to Mr. Moy and your best wishes for the future. May his hopes be realized in further experiments.

The thanks of the meeting were accorded to Mr. Moy.

The Chairman then read a paper, contributed by himself, on the "Death of Crocé-Spinelli and Sivel," the companions of M. Tissandier in the fatal balloon ascend from Paris in April, 1875.

After the reading of the paper the Chairman said: A few remarks may justly be expected from me. It seems to me most strange that these gentlemen, of different ages and different physique, should simultaneously become exhausted. I have been at the height at which this occurred several times and never felt any inconvenience. The question then arises in this way—Why did these gentlemen die? What was the cause of their death? When I was about six miles high I was insensible for want of oxygen, but when we came down I recovered again. No blood could have entered into their mouths if they had died from rarefaction of the air. It is the occurrence of the blood which seems to me to present so much difficulty. I cannot but think that, through indiscreetly throwing out a great weight of ballast, the balloon must have ascended like an arrow from a bow. The balloon would either burst or the gas escape, and it might have been that they were seated within the influence of the escaping gas, and this caused the blood to come. However I cannot satisfy myself as to what was the cause of death. I am sure we shall all feel admiration for those gentlemen who, from no light motive, made this ascent to increase human knowledge. With respect to the remark of M. Tissandier, that the extreme height of 11,000 metres was obtained by an algebraic proportion, I would add that two other independent determinations led to the same result. I never had any feeling of joy at great heights: it was one of intense agony at five or six miles; beyond that the death is painless. I had no pain after we were six miles high. Though the death itself is painless, nature seems, at certain heights, to say "go back, you are dying." I had none of that ecstatic feeling experienced by the French gentlemen. I am quite ignorant of it. Directly we approached four miles from the earth I felt pain. I am sure I may now say that this Society feels very keenly the loss of those two gentlemen who expired in the pursuit of science. A subscription has, I believe, been made for their widows and families.

Captain Burnaby gave some notes of experiments at the Crystal Palace. These, he said, had reference to an instrument he had invented some time previously for the purpose of ascertaining the direction the balloon was going when floating in a space above the clouds, and more particularly at night. As many gentlemen present knew, he had made ascents at night when it was almost impossible to get a line. The compass indicated East, West, North, and South, but the earth was hid from their view, the clouds were going the same way as they were, and, for anything they knew, they might be going towards France or Germany. He had, therefore, thought of employing two small parachutes to indicate the direction in which the balloon was travelling. The parachutes could be made of silk. They would have magnesium wire in their cars, and must be attached the one to the other by a long silken thread. This, in its turn, is fastened to a reel in the car of the balloon. On dropping one parachute it would at first fall on the motion of the balloon, but the attraction of the earth would gradually make the parachute descend. In a few seconds he would let fall a second parachute. This would act in a similar manner; and then, by drawing an imaginary line in the mind's eye from the first to the second parachute, the aëronaut could discover the direction in which he was travelling. This he believed, was most important with respect to warfare, and particularly in respect of postal balloons sent out of a fortress at night; otherwise they would not know whether they were going into the country of the enemy or that of friends. By this invention they would be able to ascertain the course of the balloon, and to know whether they should descend or continue their course. This was a subject which he believed had never been worked, and he had thought it of sufficient importance to bring it before the Society.

Mr. Wenham asked whether the parachutes could be drawn up again.

Captain Burnaby: Yes; that is the advantage, because you have a silk cord connecting the two parachutes and connected with the car by a reel, so that you cannot lose the parachutes.

The Chairman said whenever he had been above the clouds and lost sight of the earth he could always determine the direction of motion by means of the hanging grapnel rope. If the balloon was standing still the grapnel was vertical, if moving at all it was out of the vertical, and by looking at the compass he always knew in which direction he was moving. That was by daylight; but in night ascents he had still seen the rope. Captain Burnaby, who had been with him, must have remarked that the rope could be seen at night.

Captain Burnaby said they might be able to see it, but he had known cases when he could not see his hand before him. It had been so dark that he could see nothing. He had had the opportunity of talking on this subject with several of the men who went up from Paris during the siege.

The Chairman: They were sailors and inexperienced men, with the exception of M. De Fonveille and two or three others.

Captain Burnaby thought this did not meet the case. The balloon ascents were mostly made by day because there were no means of knowing the direction at night.

Mr. Wenham said he could not exactly see on what principle an anchor, suspended from a balloon, should deviate from the perpendicular. Captain Burnaby's parachutes, if left at rest, would, after a time, partake of the motion of the car; but while the parachute was being quickly raised or lowered it would have a tendency to fall perpendicularly, and the balloon at the time traversing in a direction away from the line of gravitation taken by the parachute, a sensible inclination of the suspending cord would indicate the direction in which the balloon was travelling.

The Chairman remarked that the grapnel always followed the balloon.

Captain Burnaby: At times you cannot see the anchor at all.

The Chairman: I have been in the car of a balloon when we could not see the balloon itself.

Captain Burnaby: That is what I make a great point of. That is the time when it is impossible for the aëronaut to know the direction in which he is going, but this invention of mine will enable him to do so.

The Chairman observed that Captain Burnaby spoke from practical knowledge, and that the meeting was much obliged to him for giving the result of his experience.

A vote of thanks was given to Captain Burnaby.

M. Menier read a paper, in French, on Experiments in Guiding Balloons. Several model balloons, inflated and furnished with the steering apparatus, attached to the balloon in the form of small sails, were exhibited in the room.

M. Menier said the system of aërial navigation he proposed was based upon the employment of hot air with accessory surfaces placed on each side of the balloon. A hot-air balloon was tried at Woolwich for military purposes. It was true the balloon had met with an accident, but it was also quite certain that, on the 16th October, it did rise and lifted a weight of 1,700lbs. With some change in the balloon it was his opinion it would answer for military purposes. It was this system of the hot-air balloon that had given him the idea of a plan of aërial navigation and of propelling and steering balloons. He was not quite sure he understood Mr. Moy, but if his object was simply to support one man in the air by means of machinery, he was afraid that was not the intention of aërial navigation. Aërial navigation, to be useful, must be able to take the produce of a place from that place to the place of consumption. The balloon itself seems to offer that facility, and it was for that reason he had endeavoured to steer the balloon; but what were the means of steering it? The first was the power of ascent and descent communicated to the balloon. The second was the resistance offered by the air to any surface passing through it with speed. One presented the difference of velocity and the second the difference of atmosphere. If we employed the power of ascending and descending, and the resistance of atmosphere, we might probably be able to steer the balloon. He commended his two inventions to this society, and should be glad if they could give him some support.

Mr. Moy said this plan of driving balloons was an old acquaintance of his; it was in an old number of the *Mechanics' Magazine.*

M. Menier exhibited two balloons fitted with steering apparatus and one without. The one unfitted with sails ascended vertically. One of the others with sails set took a direction to the right, the other to the left. The experiment was, therefore, in a limited space and an undisturbed atmosphere, successful.

A model upon this principle was shown by Mr. Heath at the Aëronautical Society's Exhibition at the Crystal Palace, in 1868. It was thus described in the catalogue—"Model of a balloon with a ring or belt attached, which, in ascent or descent, is placed in an inclined position relative to the axis of the balloon."

Mr. Moy said he had seen a *Mechanics' Magazine* of 1824, in which the same idea was described. If they threw out ballast to get ascensive power, and let out gas to get descensive power, they would require so much of both that they would find the process a most expensive one. A small amount of steam would drive a screw with greater power.

Mr. Wenham expressed his belief that Sir George Cayley was the original inventor of this plan.

Captain Burnaby asked if this machine could go against a wind blowing at fifteen miles an hour. In that room, where there was no draught, these fans made but a very slight deflection from the regular course. If there was so small a deviation now what would there be with the wind at fifteen miles an hour?

M. Menier said he made no pretensions at a first trial to go against the wind. He supposed the propelling and steering of the balloon must commence at one point and go on at another time to another. All he now professed to show was that it might be possible to do that which had, as yet, been done by nobody. It was not his purpose to show that this balloon could go against the wind, but he supposed learned men, as the Members of that Society were, would think it something if he showed them the balloon, without requiring it to go against the wind. They might calculate from the ascent, descent, and resistance what power could be given to the balloon.

Mr. Moy: You would save time if you would give figures.

M. Menier said he was not prepared to give figures. When it was said he should be obliged to throw out ballast and lose gas, he must explain that he only used gas for the purpose of experiment, and that he intended his apparatus to be applied to the hot-air balloon only.

Captain Burnaby expressed his disapproval of the hot-air balloon on the ground of the difficulty of inflation and the danger on touching the ground. The danger of the balloon catching fire was also to be considered. For military purposes the difficulty of inflating the hot-air balloon made it practically useless.

The Chairman could hardly believe the balloon could be guided in a strong wind, but he was sure, at the same time, they would all heartily give M. Menier their thanks.

A vote of thanks was given to M. Menier.

The Chairman, in adjourning the meeting, expressed an earnest hope that when they met again Mr. Moy would have taken another step in the direction in which he had commenced.

On the motion of Captain Burnaby the thanks of the meeting were given to the Chairman, and the meeting separated.

This report also contains various papers important for those interested in aëronautics.

SPONTANEOUS COMBUSTION OF COAL.

THE Royal Commission which was appointed in the early part of last year to inquire into "the spontaneous combustion of coal in ships, the causes and remedies thereof," held its sittings under the presidency of Mr. Childers, and its Report has been laid on the table of the House of Commons. This is a document of great practical interest and value. It indicates the conditions of safety in a matter which was previously surrounded with the greatest mystery. Board of Trade inquiries into cases of spontaneous ignition of coal had been repeatedly held, and the constant recommendation of the Courts (constituted of magistrates and nautical men) was that better ventilation should be provided. It was found, however, that these accidents happened in the best ventilated ships; and, in fact, the more generally the shipowners sought safety in ventilation the more frequent became disaster. Many sea captains had a traditional dislike to ventilating their ships, but they were overruled by insurance agents. The Liverpool underwriters recommended a special system of ventilation. The first thing an underwriter said when asked to insure a cargo of coals was, "Will your friends see, or will you see, to the ventilation?" Ventilation was stipulated for in charter-parties. In one case a witness told the Commissioners he did not want his vessel ventilated at all, but the charter-party stipulated for ventilation; so the captain ventilated with shafts up and down each hatchway connected with fore and aft shafts, and on the voyage the coal took fire and the ship was burnt. The vessel was one of four which were loaded under the tips at Newcastle at the same time, with the same coal, and from the same seam. They were each carrying from 1,500 to 2,000 tons of coal. The fates of the four are instructive. The Euxine, Oliver Cromwell, and Calcutta were bound for Aden, the Corah for Bombay, the first three ships were thoroughly ventilated; the fourth was not ventilated at all. The Euxine, Oliver Cromwell, and Calcutta were totally lost from spontaneous combustion. The Corah carried her cargo safely to Bombay. Such cases naturally led to great doubt and anxiety upon the subject. The Commission was appointed, and its report now shows that "through ventilation," at all events, is by no means an object which is to be sought. The recommendations previously made appear from the report to have proceeded upon an insufficient acquaintance with the physical facts of the subject. The Commission numbered Dr. Percy and Professor Abel among its members, and these gentlemen were requested to draw up a scientific report upon the causes which lead to the spontaneous combustion of coal in ships. Most readers of the Report will turn to this paper first.

The development of heat in coal cargoes is due to chymical changes which certain substances occurring in them undergo through the agency of atmospheric oxygen. The best known of these substances are those combinations of sulphur and iron known as iron pyrites. The presence of moisture in the air promotes the oxidation of pyrites; it does so apparently by bringing the atmospheric oxygen into more intimate contact with the surfaces of the oxidizable material. The oxidation of pyrites is accompanied by the development of heat, which may accumulate to such an extent as to lead to ignition.

There is another cause of ignition. Coal varies considerably not only in chymical composition, but in structure, some varieties being comparatively open and porous, others compact or laminated, and very friable and readily broken up. Carbon in a finely divided or porous condition has the property of absorbing and condensing within its pores large volumes of certain gases, among which is oxygen. The condensation of a gas by a porous body is attended by the development of heat. Moreover, the tendency to oxidation which carbon and certain compounds of carbon possess is favoured by the condensation of oxygen within their pores, whereby the very intimate contact between the carbon and oxygen particles is promoted. Hence the development of heat by absorption and the establishment of oxidation occur simultaneously. Oxidation is accelerated as heat accumulates; chymical action proceeds so energetically that the carbon may be heated to igniting point. The breaking up of the coal before and during shipment by the rough usage to which, for the sake of speedy loading, it is often subjected, obviously favours the absorption of oxygen and increases the tendency to heating by this second process. The second process is not, like the first, facilitated by moisture; on the contrary, the wet fills up the pores and diminishes the power of absorbing oxygen.

In a tropical voyage, coal, confined in the close hold of a ship, will accumulate an amount of heat which no ventilation practicable in those circumstances will suffice to remove. "Such circulation of air as may be established, even in the less compact portion of the cargo, is not likely to have any valuable cooling effect, and the circulation, if there be any, must be very feeble among the more closely lying masses of small coal; so that heat, if developed in these, will accumulate undisturbed." Indeed, its development would be favoured by the fresh supply of oxygen with a gradual replacement of the air surrounding those parts would convey, "so that a period would be reached sooner or later when the development of heat would be most seriously promoted by ventilation."

Such is the conclusion of the scientific members of the Commission. It was borne out by the statistics and the other evidence collected. Spontaneous combustion occurred principally in vessels carrying cargoes of over 500 tons and bound to the West Coast of South America, San Francisco, or to Asiatic ports beyond the Mediterranean and Black Seas. Of such shipments over 4 per cent. suffered in 1874; and though they only amounted to 1,181 out of the 31,116 shipments for the year, yet among them occurred 51 out of the total of 70 casualties. Out of the same 70 casualties only ten occurred in shipments to European ports. But the shipments to European ports amounted to 10,513,181 tons of coal; while the 60 cases occurred in the shipment of 2,855,831 tons of coal to Asia, Africa, and America. Thus the Commissioners found that the calamities occurred chiefly in tropical voyages. They also ascertained that the percentage of loss increased with the amount of the cargo.

The increase in the number of casualties in 1873 and 1874 was traced in a large measure by one of the witnesses (Mr. Cooper Rundell) to want of care in the selection of coal. "The coals shipped in 1874," he said, "were most probably not so free from pyrites and small coal as the coals shipped in the preceding years." This was thought by him and another witness to be due to the Mines Regulation Act, which withdrew from the works for the purposes of education boys who used to pick out the "brassy" pieces of coal. The Commissioners found it generally recognized in the trade that the breakage of coal was an evil to be guarded against, and a great part of their report is devoted to a description of methods of loading by which it is sought with more or less success to avoid the breakage of coal in shipment. Their conclusion is that the machines known as "tips" and "spouts" conduce most to the breakage of the coal. In the system of loading by hoist or by crane the fall from the bottom or end of the waggon into the ship's hold is as great as from the mouth of the shoot or spout; but the coal until released from the waggon, is literally undisturbed, and the fall from the bottom or end of the waggon, as the case may be, into the spout, together with the concussion of the coal in its passage down the spout, is avoided. Even in this system, however, the fall of the coal first put on board is in deep ships very considerable. To obviate the breakage consequent on this fall anti-breakage boxes were introduced. Some merchants load by barrows, and thus escape the loss and danger consequent on the breaking up of the coal. The system is slow and expensive, but it is sometimes stipulated for in charters. The Peninsular and Oriental Company are among those who use the box or barrow system. The other systems of loading lead to the accumulation of small coal under the main hatch. It had been noticed by witnesses examined by the Commissioners that the burnings of ships often commenced under the main hatch; but the principal objection of shipowners to the breaking of coal was that it diminished the value of the cargo. The Commissioners now find that the breakage is not only unprofitable, but dangerous.

The Commissioners observe that there is a very common confusion between explosions and spontaneous ignition. Explosions are never spontaneous. The gas which causes explosions in mines or on ships is marsh gas—light carburetted hydrogen. When mixed with a considerable volume of air it forms a compound which will explode on contact with flame. If coal, from seams which are charged with marsh gas, is placed on board ship shortly after being raised from the pit, there is obviously great liability to the formation of an explosive atmosphere in the hold or bunkers. Dr. Percy and Professor Abel observe in their paper appended to the Report:—"Every possible means should in such cases be had recourse to for facilitating the escape of gas from the coal into the open air. But, as the gas requires a large admixture of air to render it violently explosive, it is obvious that any attempt to ventilate the coal by passing or drawing air into the *body* of the freight would be most likely to favour the production of a highly explosive mixture of gas and air. The only useful application which might be made of any special means of ventilation with a view to diminish the risk of explosions would be to pass a current of air *over* the coal and immediately into the open air, so as to accelerate the escape and removal of the inflammable gas."

The Commissioners very briefly discuss means of extinguishing fire by generating carbonic acid gas and applying it to the ignited portions of a coal cargo; but are of opinion that, as this gas has no cooling effect, it will not be useful in the case of any considerable mass of ignited coal. In such a case water and steam are the only agents practically available.

Finally, the Commissioners submit conclusions, summarized as follows by themselves:—

"1. That certain descriptions of coal are intrinsically dangerous for shipment on long voyages.

"2. That the breakage of coal in its transport from the pit to the ship's hold, the shipment of pyritic coal in a wet condition, and especially ventilation through the body of coal cargoes, conduce to spontaneous combustion even though the coal may not be unfit for conveyance on long voyages.

"3. That spontaneous combustion in coal cargoes would be less frequent if regard were had by shipowners and underwriters to these facts.

"4. That when coal is being carried on long voyages the temperature in the various portions of the cargo should be tested periodically by thermometer, and registered in the log.

"5. That, with a view to guard against explosion, free and continuous egress to the open air, independently of the hatchway, should be provided for the explosive gases by means of a system of surface ventilation which would be effective in all circumstances of weather.

"6. That, in order to make known the descriptions of coal liable to combustion, the Inspector of Mines should be instructed to hold inquiry into all cases of spontaneous combustion occurring in cargoes of coal taken from their respective districts, exporters being required always to record on their specifications the denomination of the coals forming the cargo.

"7. That no additional legislation with reference to the conveyance of coal by sea is required, unless for the purpose of giving effect to our proposals with regard to the inquiries by Inspectors of Mines, and to the fuller specification of coal entered outward at Her Majesty's Customs."

AMERICAN INVENTIONS.

Stench Trap.—Edward F. Hutchins, Toronto, Canada.—In order to so improve the metallic stench trap in common use that the bursting of the same by freezing is avoided, and that the detaching of the trap for cleaning or melting the ice may be readily accomplished, this inventor proposes a stench trap made of an elastic material, connected in a detachable manner to the pipes.

Velocipede.—R. Walcot Laurence, New York City.—This invention consists in mounting the steering wheel on the reach of a lever pivoted to the seat and arranged in an axle guide, extended forward to the foot rest. It can be worked by the feet to guide the carriage while the propelling power is applied by hand, and the carriage can also be guided by the driving wheels by turning one faster than the other.

Plough.—David H. Jarrard, Talladega, Ala.—This plow is so constructed that the plow standard may be adjusted to give any desired pitch to the plough, and may be held securely in place when adjusted, and which will support the wing of the plough plate to prevent it from being bent or broken.

Mowing Machine.—Charles B. Martyn, Waupun, Wis.—This improves the construction of reapers and mowers in such a way as to convert the long and unequal stroke of the connecting bar into two short and equal strokes of the sickle with a motion of uniform velocity.

Butter Worker.—Charles Plyer, Hempstead, N. Y.—This invention consists of a concave dish with raised center, to which a lever, of a shape corresponding to the dish, is swiveled. This is to be worked all around the dish for cutting up the butter.

Grain Header.—Charles K. Myers and John W. Irwin, Pekin, Ill., assignors to said Myers and Peter Weyrick, same place. —The object here is to improve the construction of grain headers, so that the reel may be moved farther from and closer to the cutter bar automatically as the cutter bar is raised or lowered to operate upon taller or shorter grain. The device includes five new mechanical constructions.

Faucet.—Patrick Skelly, New York city. —This relates to improvements in faucets for barrels of all kinds, that a tight seating of the stopcock without leakage, and a superior and readily applied coupling with the liquid-conveying pipe, are obtained.

Soap Frame.—Daniel Whitaker, Boston, Mass.—This soap frame can be conveniently set up and taken down, and its side and end plates are more firmly connected than others of its class. The base of the frame is made in three parts, secured to each other by transverse screw bolts, whereby they are adapted to enter grooves in the base of frame, and are attached thereto by hooks and staples. The end portions of the frame have clamping bars attached, whereby they may be locked to the sides, in such a manner as to hold the ends vertical, and form a tight joint between them and the sides and lastly, the side portions of the frame are provided with trusslike braces, whereby they are prevented from buckling, warping, etc.

Combined Stereoscope and Graphoscope.—James Lee, New Brighton, N. Y.—When the lens holder is raised into an erect position it is caught and held by a spring catch, and is thus not liable to fall back and mar the instrument or break the lenses. Wings or side shields are employed to keep the light from the eyes when using the istrument. Said wings may be closed against the lens holder.

Projectile.—James M. Pollard, New Orleans, La.—This invention consists in a projectile having a central cylindrical portion, which ends symmetrically tapered to a conical or paraboloidal form, the rear end of the projectile being upset or molded with a raised circumferential bur, which is of less diameter than the cylindrical portion, and has a convex end. The double paraboloidal form adapts the projectile to the least resistance from the air, while the raise bur acts in the nature of a guide, as a feather to an arrow.

Feathering Paddle Wheels.—John H. Clow, Orange, Wis.—Certain improvements are made in that class of paddle wheels designed for the propulsion of boats in which the paddles are pivoted upon one side of the center so as to feather or move edgewise in rising from the water so as not to carry dead water. The invention consists mainly in the particular construction of a locking belt, arranged to be operated by a lever and cam, and located in the central part of the wheel so as to engage with the middle part of the paddle, and lock or release the same at the proper time.

Portable Derrick. — Shirwood Y. Reams, Belleville, Texas.—This consists of an adjustable crane mounted on a truck platform, having an overhead frame for the support of the upper end of the crane post, and braces for staying the frame. The crane can thus be turned around to overhang the sides. The whole is a simple apparatus, which may be moved readily from place to place by hand or by horse power.

Windmill.—James Ward, Winnemucca, Nev.—This consists of an upright wheel with spirally curved floats, in connection with a corresponding number of fixed and hinged and weighted shutters, of which the latter are regulated by weights and a connecting governing string.

Auger Handle.—James Magers, Gervais, Oregon.—By suitable construction, a locking plate prevents the bit from turning in the handle when the auger is in use, and at the same time allows the bit to be readily detached and attached when desired.

Tire Upsetter. — Ebenezer B. Rose, Goshen, assignor to himself and George M. Bull, New Baltimore, N. Y.—The tire or other iron to be shrunk is heated, placed upon plates, and clamped against toothed blocks by eccentrics. Then one plate and its toothed block and eccentric are forced forward, shrinking the iron.

Inhaler.—George L. Crosby, Hannibal, Mo.—This invention consists in combining a glass stopper, having an acid receptacle and air passages, with a grooved stopper and tubes. From the acid receptacle the fumes are drawn down through a tube into the liquid in the body of the inhaler, to be inhaled through a flexible tube.

Stopper for Ship's Running Gear.—John W. Knight, New York City.—The object of this invention is to prevent the chafing and wear of the sail of a vessel from the rope or buntline by which it is drawn up; and it consists of a stopper attached to the mast or any part of the rigging by which the rope is held, so that it will hang loosely over the sail, and so that when the fall of the rope is hauled in, it will let the rope go free.

Faucet Attachment.—Harry L. Sadler, Brooklyn, N. Y.—This invention consists of a screw threaded bushing of the faucet hole, in connexion with an interior tube, having recesses, and a wooden closing plug. The plug tube has interior projections, that are engaged by lugs of a hollow and threaded key that screws into the bushing and carries in a socket with wooden lining, the faucet, opening or closing the keg by the insertion or withdrawal of the faucet key.

Cartridge. — Albert Hall, New York City. — This relates to improvements in the construction of paper cartridge shells, by which the same are considerably stiffened, and the anvil rigidly and strongly secured in position in the shell. The invention consists of a diametrical anvil, made in one piece with an encircling socket tube, retained securely by a paper shell and metallic cap piece.

Shoe Fastening.—William J. Vitt, New York City.—The flap is fastened to the upper by a number of tubular clips applied to the shoe. The clips of the flap and upper are arranged to alternate with each other, and connected by a string that is secured by a knot to the lowermost clip. The string is then passed through all the clips, the upper end giving readily for the opening of the flap in putting on or taking off the shoe. The end of the string is applied to and rigidly retained by a suitable clamping device, and then passed through a hole or eyelet of the upper to the inside to be wound round the ankle.

Sash Fastener.—Thomas Hill, Portland, Me. — The invention relates to a fastener so constructed and applied as to lock the upper and lower sash together in any adjustment. The fastener consists of a notched and slotted plate, secured to the side bar of the upper sash, and a button or catch pivoted to the top of the lower sash, the arrangement being such that the catch works in the slot of the plate, and engages the notches thereof to hold the sash at the desired height.

Leather-Stretching Machine. — Wm. Coupe, South Attleborough, Mass.—This is an improved machine for stretching leather for belts and other uses, so constructed as to stretch the leather evenly when varying in thickness, and which may be readily adjusted to stretch the leather to any desired extent.

APPLICATIONS FOR LETTERS PATENT.

(*Continued from page* 126.)

On May 1st.—1815 to 1832.—T. M. J. Marsh and J. C. Fell. Apparatus for lubricating the spindles employed in machinery for spinning and doubling cotton and other fibrous substances.—W. Pollard and S. Bramwell. Apparatus for doubling yarns.—J. G. Tongue. Fountain lamps (com.)—H. Stanwix. Grinding and polishing machines.—B. Mountain and J. Mountain. Machinery or apparatus employed in the manufacture of cut nails, sprigs, and flooring brads.—E. F. J. A. Gervais. Machine or apparatus for corking bottles.—H. A. Dufrené. Sewing machine (com.)—W. R. Lake. Harvesting machines (com.)—R. Watkinson and T. Stafford. Universal joint for coupling pipes and for stoppering bottles.—B. J. B. Mills. Apparatus and process for extracting saccharine and other vegetable juices (com.)—W. H. Pickles and J. Pickles. Machinery for spinning fibrous substances.—G. Pratt. Buckles used for connecting leather straps.—E. T. Hughes. Gas light extinguisher (com.)—J. C. Ward. Pianofortes.—H. Green and B. Sykes. Roller skates.—A. M. Clark. Combined calendar and time-piece with perpetual automatic adjuster attachment for the irregular number of days in the different months (com.)—A. M. Clark. Apparatus for charging gas retorts (com.)—E. Brown and F. Brown.—Apparatus for controlling or regulating the motions of horses, the said apparatus being also applicable to the breaking in of horses.

On May 2nd.—1833 to 1853.—A. Bresson. Railway river bridge.—R. C. Oats. Reaping and mowing machine attachments.—F. M. Delatre. Life and other boats.—C. Pieper. Machinery for carding wool and other fibrous material (com.)—J. Bardsley and R. Hargreaves. Connections of apparatus for drawing off liquors or liquids from casks.—W. Benson. Apparatus for spinning and doubling yarns or threads.—B. Hunt. Tanning and apparatus connected therewith (com.)—E. Edwards, E. C. Hammond, and A. Edwards. Roller skates, partly applicable to other purposes.—H. E. Newton. Printers' galleys (com.)—J. C. Ward. Musical instruments.—C. Boyce. Anchors.—J. Chisholm and J. Clegg. Self-acting mules for spinning and doubling.—J. Howarth. Apparatus for heating the cylinders of machines for calendering, mangling, and drying.—F. J. Hamel. Preparation of materials for the manufacture of artificial fuel by means of special machinery.—W. Wright. Union joints for connecting pipes or tubes with cocks, taps, or faucets of ale, wine, and other casks or barrels, and for similar purposes.—J. E. Piper. Treatment of milk for use as food.—B. Healey. Evaporating apparatus.—W. Thomas. Manufacture of barred, ribbed, and figured fabrics.—R. Simpson, A. Brooke, and T. Royle. Preparation of alizarine and other analogous colouring matters made from anthracine.—W. Hartnell. Means or apparatus employed for governing steam engines.—W. R. Lake. Method of and apparatus for condensing the exhaust steam of steam engines (com.)

On May 3rd.—1854 to 1868.—F. Pearn and S. Pearn. Arrangements of mechanism or apparatus for extinguishing fires in mills, warehouses, and other buildings.—S. Wekey. Contruction of roller skates.—Col. H. F. S. D'Esplaviz. Manure.—J. P. Smith. Buckled plates and mechanism for the manufacture of the same, which said mechanism or apparatus is applicable for shaping or forming articles from sheets of metal.—T. Phillips. Preventing telegraph posts from being prostrated and blown down permanently or being broken and destroyed by wind, snow, or other means.—L. Haslam and C. Marshall.—Construction of looms used for fancy weaving.—H. J. Chadwick and J. Giggle. Method of and apparatus for lubricating the cylinders of steam and other engines.—J. Murgatroyd, W. Rothwell, A. Battinson, and W. Sutcliffe. Weaving and apparatus connected therewith.—P. Jensen. Fire alarms or apparatus for indicating to the inmates of a building that a fire has broken out therein (com.)—G. H. Spicer. Manufacture of candles.—T. Temple, W. Clark, and J. Clark. Hydraulic governor for marine and land engines.—A. Lloyd. Preparation of articles of food and drink.—W. Clark. Automatic switch-locking and signal apparatus for railways (com). J. W. Girdlestone. "Dry" closets, commodes, and urinals.—H. Negretti and J. W. Zambra. Hydrometers for measurimg the density of liquids or the specific gravity of solid substances.

On May 4th.—1869 to 1879.—J. Hoyle, J. Richards, and W. Heyes. The method of forming ceilings, and the formation and preparation of materials to be used in the construction of ceilings and partition walls.—J. Hirst. Spring for use in washing, wringing, and mangling machines.—J. Goodrick. Manufacture of web halter heads.—G. MacLellan. Packing for steam engines, pumps, and other like purposes.—H. Walker. Manufacture of scissors, shears, and other edge tools.—G. T. Bousfield. Art of transmitting and analyzing musical impressions or sounds telegraphically, and apparatus for so transmitting and analyzing such sounds (com.) Complete specification.)—G. Barbaudy. Bread or food for cattle, and more especially for horses, entitled "Scotch bread."—A. Gavin. Railway brakes and parts connected therewith (partly com.) J. Somerville and J. F. Suthven. Tramway rails and wheels.—R. W. Wallace. Refractory or fire-resisting compound.—A. A. Leaker. Cushion for billiard tables.

On May 5th.—1880 to 1905.—T. Lane. Fire-place.—R. Gardner. Modes of and apparatus for crushing or breaking rock and other substances.—D. Heath. Washing-machines.—R. J. Miller. Spring rollers for blinds and other purposes (partly com.)—M. Runkel. Cab fare indicator.—A. Edwards. Machine for cleaning and polishing boots and shoes.—J. A. Mays. Rollers or wheels of roller skates.—C. T. Leach. Roller skates and rollers for use with the same.—K. R. Schramm and G. O. Walker. Indicators.—W. Marx. Locking desk or easel for albums.—E. Barnes, E. Salmon, and J. S. Sawrey. Mangling, wringing, and drying machines.—J. B. Denton. Filtering or purifying water, and the apparatus employed therein.—W. H. Green. Manufacture of hats and caps.—C. Rawson and J. W. Slater. Treatment or purification of sewage and other matters, and the preparation of agents to be used in such treatment, some of which are also applicable to other purposes.—J. B. Fenby. Machinery and apparatus for engraving and carving, and for other like purposes.—W. R. Lake. Atomizers or apparatus for diffusing liquid perfumes (com.) (Complete specification.)—W. P. Wyatt. Apparatus for adjusting and securing the knobs or handles of locks, latches, or other fastenings.—T. P. Young and J. Fletcher. Machinery for warping and beaming.—H. Ford. Construction of cupola or foundry furnaces for the melting and purifyng of iron and other metals.—A. L. Dowie. Apparatus connected with smelting of metals and metallic ores, especially the smelting of zinc from the ores and the prevention of loss of zinc during the process.—I. L. Pulvermacher. Apparatus or appliances connected with generating, conducting, measuring, or testing and applying electricity.—F. Walton. Apparatus for the re-distillation or rectification of spirits.—T. Blinkhorn and B. Browning. Slide valves for steam and other engines.—W. Clark. Ship and other compasses (com.)—E. Solvay. Manufacture of carbonates of soda by the ammoniacal process.—W. R. Lake. Manufacture of wood screws, and machinery therefor (com.) (Complete specification.)

On May 6th.—1906 to 1919.—A. B. Childs. Machinery for cleaning grain, rice, and seeds, or bolting flour, and separating and purifying middlings therefrom.—W. Frost. "Washer" for locking or preventing nuts from working loose.—C. D. Abel. Tempering glass bottles and other hollow glass articles, and apparatus therefor (com.)—W. Martin, junr., D. R. Dawson, and R. Orchar. Laing's overhead sewing machines.—J. H. Bailey. Apparatus for signalling on railways.—J. Cole, senr., and J. Cole, junr. Roller or rink skates.—W. L. Grigg. Brick machines.—J. Smith. Water gauges, applicable also to gauge, steam, and other cocks.—W. J. Hodgetts. Ornamenting articles of glass, and machinery or apparatus employed for that purpose.—J. Strick. Construction of instrument for taking linear dimensions and measuring distances.—G. Piedbœuf. Apparatus for the manufacture of steam boilers.—G. Gledhill. Electrical stop motions or alarms for machinery for carding, roving, spinning, weaving, and other operations connected with the preparation and manufacture of fibrous substances.—C. T. Price. Candlesticks.—M. H. Smith and J. T. Simpson. Construction of combined writing table and secretaire.

On May 8th.—1920 to 1932.—K. Knott. Method and apparatus for preserving meat for transportation and storage. (Complets specification.)—E. Renoult. Manufacture of driving bands for machinery.—W. Gladwyn. Machine or apparatus for ironing linen and other articles.—A. Barff and A. Bradshaw. Steam traps.—T. Mitchell and M. Mitchell. Apparatus for relieving safety valves, and for indicating low water in steam boilers, also partly applicable as a safety valve for domestic hot-water boilers.—J. Mabson. Portable apparatus for transmitting rotary motion to various appliances with a special reference to the method of supporting it, and making it easy of movement in various directions or not, and firm, when required.—J. H. Nobbs. Velocipedes.—H. Deacon. Manufacture of chlorine.—F. Wirth. Petroleum cooking apparatuses (com.)—W. R. Lake. Projectiles for ordnance (com.)—W. Clark. Treating sewage water to obtain valuable products therefrom (com.)—W. Clark. Electro-magnetic machines (com.)—E. G. Brewer. Looms for weaving (com.)

On May 9th.—1933 to 1952.—Rbt. Sutton and Rcbrd. Sutton. Manufacture of sail and roping twines and other twines, and apparatus used therein.—J. R. Wright, jun. Construction of hand truck.—W. Bright. Roller skates.—G. Lewis and E. S. Lewis. Stay busks.—T. Griffin. Preparing stereotype plates for printing.—S. Lake and C. J. Southgate. Screw-propellers.—H. Schooling. Safes.—C. Ritchie. Apparatus for utilizing heat for lighting, heating, and ventilating.—J. Whitlow. Roller skates.—J. H. Sanders and S. Sanders. Furnaces (com.)—W. H. Thomas. Sewing machines.—W. T. Henley. Insulated electric telegraph conductors, and the mode of and means for protecting telegraph wires when used for subterranean, submarine, or other lines.—J. Higginbottom. Steam boilers or generators.—J. Wallis. Additions to theodolites and other similar instruments to facilitate their use for measuring and ascertaining distances.—R. Ogden and P. Ogden. Roller skates.—E. Brook and A. Wilson. Apparatus for making gas.—W. L. Wise. Steam engines (com.)—J. M. Frudd and T. Harrison. Hoes for farming purposes. J. Muirhead. Apparatus for igniting and extinguishing a number of gas lamps simultaneously (com.)—W. Clark. Railway carriage axles (com.) (Complete specification.)

On May 10th.—1953 to 1972.—S. S. Allin. Constrution of roller skates.—W. Clark. Wheel barrows and seed-sowers (com.)—W. Clark. Machinery for trimming playing cards and other uses (com.)—W. Astrop. Folding perambulators.—R. Taylor. Annealing plates of iron used in the manufacture of tin or terne plate and for other purposes, and known as "black plate."—R. Wülfing. Buttons (com.)—P. Winton. Potato digger—H. Harrison. Dry stench tray to prevent the effluvia arising from street and other drains.—C. T. E. Lascelles. Gas and other explosive motive-power engines.—A. E. Joyce. Roller skates.—R. Burtles. Self-acting machine for cutting, grinding, and polishing glass.—J. Metcalf. Construction of boilers for heating and circulating water.—W. Clark. Feed-water apparatus for steam boilers (com.)—R. Berryman. Apparatus for heating water, air, or other fluids, also applicable to condensers.—T. E. Smith and J. Smith. Gill-boxes for preparing wool for combing.—J. Barbour. Fluting machines.—A. Robottom. Preserving animal and vegetable substances.—S. Barbour and J. Barbour. Balling machines.—H. E. Newton. Construction of machines for ironing articles of wearing apparel and fabrics (com.)—J. Musgrave. Steam engines.

On May 11th.—1973 to 1991—W. E. Newton. Treatment of the refuse or sludge oil produced in the distillation or purification of crude petroleum, asphalte, bitumen, and other substances from which hydrocarbon oils are obtained, the object of such treatment being to obtain useful products therefrom (com.)—J. W. Saunders. Roller skates.—W. Hartcliffe, sen. Apparatus for lubricating the spindles employed in machinery for spinning, doubling, or twisting fibrous materials, also applicable in part or on the whole to the rotating and sliding portions of other machinery.—D. Rees. Compounding calves'-feet jelly tablets.

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